CHANGES IN SEGREGATION PATTERNS IN MEDIUM-SIZED CITIES IN THE STATE OF SÃO PAULO BETWEEN 2000 AND 2010

Agnes Silva Araujo[*]
Joana Barros[**]
Marcus Vinícius Pereira Saraiva[***]

*Pontifícia Universidade Católica do Paraná, Programa de Pós-graduação em Gestão Urbana, Curitiba, PR, Brazil
**University College London, The Bartlett Centre for Advanced Spatial Analysis, London, United Kingdom
***Birkbeck, University of London, Department of Geography, London, United Kingdom

Abstract

Brazil underwent political and economic changes that led to a reduction in social inequalities between 2000 and 2010. Studies indicated that during the same period, there was an increase in the level of residential segregation in metropolitan spaces, as opposed to a reduction accompanying the inequalities. This paper contributes to this body of studies, by analyzing residential segregation in medium-sized cities, quantitatively and spatially, during the period between 2000 and 2010. The study aims to quantify the degree of segregation in five medium-sized cities in the state of São Paulo and analyze the evolution of their spatial patterns, via a comparative perspective. The measurement of segregation, using global and local spatial indices, has indicated an increase in residential segregation similar to those identified by studies for metropolitan areas, in which the highest and lowest income groups are markedly the most segregated. However, this was not the case for all cities, an unchanged degree and pattern of segregation were also identified during the same period in one of the cities. These results are discussed within the context of the urban changes that have taken place in medium-sized cities, such as the valorization of real estate in specific sectors of the cities, amidst the continued process of peripheralization of the low-income population.

Keywords

Segregation; Medium-Sized Cities; Urban Spatial Patterns; Spatial Indices of Segregation.

MUDANÇAS NOS PADRÕES DE SEGREGAÇÃO DAS CIDADES MÉDIAS NO ESTADO DE SÃO PAULO ENTRE 2000 E 2010

Agnes Silva Araujo[*]
Joana Barros[**]
Marcus Vinícius Pereira Saraiva[***]

* Pontifícia Universidade Católica do Paraná, Programa de Pós-graduação em Gestão Urbana, Curitiba, PR, Brasil
**University College London, The Bartlett Centre for Advanced Spatial Analysis, Londres, Reino Unido
***Birkbeck, University of London, Department of Geography, London, Reino Unido

Resumo

O Brasil passou por mudanças políticas e econômicas que levaram à redução das desigualdades sociais no período entre 2000 e 2010. Estudos apontam que nesse mesmo período o nível de segregação residencial nos espaços metropolitanos aumentou, ao contrário de uma redução acompanhando as desigualdades. Este artigo vem contribuir com essa frente de estudos, analisando a segregação residencial em cidades médias, quantitativamente e espacialmente, no período entre 2000 e 2010, com o objetivo de quantificar o grau de segregação em cinco cidades médias paulistas e analisar a evolução de seus padrões espaciais, por meio de uma perspectiva comparativa. A mensuração da segregação, utilizando índices espaciais globais e locais para as cidades selecionadas, indicou uma tendência de aumento da segregação residencial similar aos identificados por estudos para áreas metropolitanas, no qual os grupos socioeconômicos de altíssima e baixíssima renda se destacam como os mais segregados, mas não para todas as cidades. Também foram identificados grau e padrão de segregação inalterados no mesmo período. Esses resultados são discutidos no contexto das transformações urbanas ocorridas nas cidades médias, incluindo a valorização imobiliária de determinados setores das cidades, enquanto os processos de periferização da população de baixa renda se mantiveram.

Palavras-chave

Segregação; Cidades Médias; Padrões Espaciais Urbanos; Índices Espaciais de Segregação.

CHANGES IN SEGREGATION PATTERNS IN MEDIUM-SIZED CITIES IN THE STATE OF SÃO PAULO BETWEEN 2000 AND 2010[1]

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1. Introduction

Segregation is considered a characteristic of contemporary cities (Logan, 2000; Marcuse, 2001; Poulsen; Forrest; Johnston, 2002) and can be defined as the geographic and/or social separation of different population groups in urban space (White, 1983). Thus, a segregated city is one in which there are spatial patterns that limit the possibility of contact between different population groups, as well as access to public and institutional resources – such as schools, hospitals, parks, jobs, etc. (Reardon, 2006). To understand urban segregation, it is necessary to specify the social dimension (racial, ethnic or socioeconomic) (id., ibid.) and the socio-geographical spaces (residential, leisure, work, etc.) that are under analysis (Farber; Páez; Morenci, 2012; Jakle; Brunn; Roseman, 1976; Palmer, 2013).

This paper analyses residential segregation from a socioeconomic perspective. The study of residential segregation is essential to understand segregation as a geographic problem, in which the location of residences is a determinant for the urban living experience, including access to opportunities (Li et al., 2020). Similarly, the socioeconomic dimension remains key for the understanding of urban segregation in Brazil and Latin America (Marques; Torres, 2004; Sabatini; Sierralta, 2006; Thibert; Osório, 2013; Telles, 1995). Even studies

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that analyze the racial dimension of segregation in cities in the Global South have identified an association between socioeconomic and racial segregation (França, 2016; Haque et al., 2021; Van Rooyen; Lemanski, 2020).

In Brazil, studies on socioeconomic residential segregation in the 1970s and 1980s focused on the center-periphery spatial macro-pattern and the development of extensive peripheral areas devoid of urban infrastructure, and predominantly occupied by groups of a lower socioeconomic status (Bonduki; Rolnik, 1979; Kowarick, 1979; Maricato, 1979; Santos, 1978). Subsequently, studies have identified a change in spatial patterns and a tendency for "self-segregation" among classes with a higher socioeconomic status (Caldeira, 2000; Villaça, 1998). Such a trend led to neighborhoods sectorizations which resulted in sectors that extended outward from the central area towards the periphery that concentrated the population of high socioeconomic status in enclosed residential spaces.[2] This process resulted in a heterogenization of the peripheries and improved urban infrastructure with the allocation of such spaces (Caldeira, 2000; Coy; Pöhler, 2002; Marques; Torres, 2004; Villaça, 1998).

With the political and economic changes in the early 2000s in Brazil, economic growth resulting from the "commodity boom" in association with policies to reduce unemployment, income transfer, and access to higher education, led to a reduction in social and economic inequalities (Marques, 2014; 2016). It was assumed that segregation would also decrease as a consequence of reducing inequalities. Empirical evidence, however, indicate that segregation has not only persisted in metropolitan spaces during the period from 2000 to 2010 but has actually increased between high and low socioeconomic groups (Feitosa et al., 2021; Marques, 2016).

During this same period, the spaces occupied by the elites also became more homogeneous and urban peripheries more fragmented and heterogeneous, albeit maintaining the center-periphery pattern (Feitosa et al., 2021; Marques, 2016). The development of high-end enclosed residential spaces in the peripheral areas where the population of lower socioeconomic status predominated, has contributed to an increase in fragmentation and heterogenization of those areas without, however, minimizing the overall segregation that is now concentrated at a micro level (Feitosa et al., 2021).

2. According to Sposito and Góes (2013), the term "enclosed residential spaces" (in Portuguese, "espaços residenciais fechados") refers both to "condominiums", in which the common use areas of the condominium owners are privately owned, and "lotissements", whereby, in legal terms, while the social and circulation areas are public in legal terms, but the typology restricts the use to residents only. In English, a common term for such residential developments is "gated communities".

The vast majority of studies on urban segregation in Brazil have focused on metropolitan regions, particularly São Paulo (Feitosa et al., 2021; França, 2016; Marques, 2016). There are few studies that analyze the spatial patterns and degree of segregation in medium-sized cities from a quantitative perspective (see Prado, 2012; Rocha, 2011), in particular looking at changes in segregation patterns and levels between census periods, to which this research aims to contribute.

The objective, therefore, is to examine the changes in the residential segregation levels and their spatial patterns in five medium-sized cities in the state of São Paulo (Araçatuba, Bauru, Marília, Presidente Prudente and São José do Rio Preto) between 2000 and 2010. For the analysis, spatial indices of segregation (local and global) were applied to socioeconomic data (income groups) from the 2000 and 2010 censuses of the Brazilian Institute of Geography and Statistics (IBGE, 2000; 2010).

The article is organized as follows: the next section discusses the historical processes of urban (re)structuring in medium-sized cities in the state of São Paulo, the conformation of segregation patterns in previous periods and its current dynamics. The following section addresses the methodology and presents the spatial indices used to measure segregation. Subsequently, the results are presented and discussed within the context of the literature on medium-sized cities. The article concludes with final considerations.

2. Medium-sized cities in the state of São Paulo

This study covers five medium-sized cities located in the northwest and central-west regions of the state of São Paulo: Araçatuba, Bauru, Marília, Presidente Prudente and São José do Rio Preto (Figure 1). These cities have been classified as medium-sized by several authors (Boscariol, 2017; Gomes, 2007; Sposito; Góes, 2015; Melazzo, 2006), following the methodology proposed by Sposito et al. (2007), which, in addition to population size, also considers the city's degree of influence and connectivity in the regional urban network; the existence of contemporary forms of spatial organization of activities linked to the trade of goods and services (such as shopping malls); the increasing complexity of spatial configurations and the widening socio-spatial inequalities.

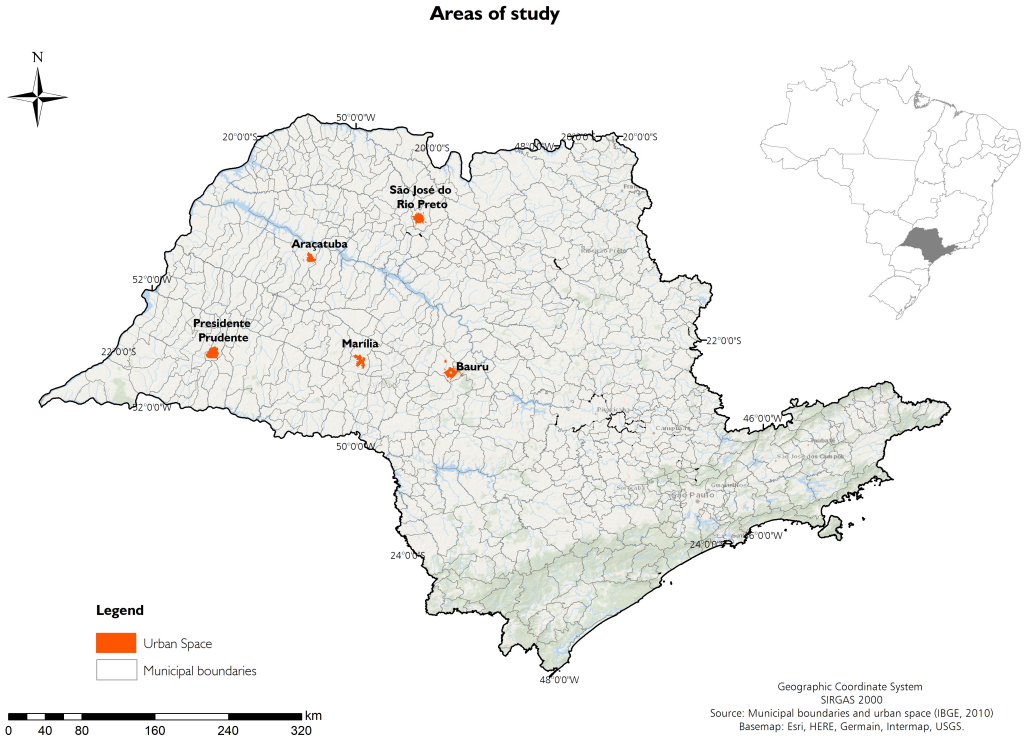

Figure 1. Location map of the study areas
Source: The authors (2023) based on IBGE (2010) data.

The rise in residents' purchasing power in medium-sized cities, driven by the National Development Plan (known as II PND), coupled with a demand for high-quality housing and the emergency of shopping centers, fostered the development of enclosed residential spaces (Sposito, 2004; Sposito et al., 2007; Sposito; Góes, 2013), thereby inducing transformations in segregation patterns (Araujo; Barros; Queiroz, 2018; Sobarzo, 1999; Sposito, 2003; 2004; 2006; Zandonadi, 2008).

While high-end enclosed residential spaces have multiplied across metropolises, in medium-sized cities, developments aimed at middle-income groups were predominant– a reflection of the comparatively lower exchange value of housing (Sposito, 2006). The locations of these projects in medium-sized cities are predominantly peripheral due to greater accessibility and ease of travel, typical of a less dense roadway system (Sposito, 2006). They are also dispersed, forming urban expansion vectors that can be associated with processes of non-spontaneous valorization, with the presence of vacant urban land that become susceptible to real estate speculation (Leme, 1999). Due to such dynamics, the peripheries of medium-sized cities in the state of São Paulo have become more heterogeneous

and fragmented with the presence of such enterprises, new spaces for the commercialization of goods and services (shopping centers), often amalgamated with pre-existing industrial uses (Sposito, 2004).

Within this context, it is important to highlight some singularities in both the production and restructuring of urban space in the medium-sized cities studied. While Marília and Presidente Prudente followed the typical pattern discussed above, with the development of an urban expansion vector where high and middle-end enclosed residential spaces and vacant urban land are located, Araçatuba presents different dynamics, with fewer vacant land, the result of an early process of urban expansion that went from the eventual incorporation of land to a business dynamic. (Boscariol, 2017). Additionally, in Bauru and São José do Rio Preto, the process of urban expansion proved to be an aggravating factor: a significant part of the urban land was incorporated by the expansion of irregular subdivisions (id., ibid.; Coimbra, 2018). These contextual aspects and the historical trajectories of occupation provide a basis for analyzing the changes in segregation patterns during the period between 2000 and 2010 and make it possible to understand the extent to which spatial patterns of segregation are resilient to the general trends observed over the period.

3. Methodology

3.1. Indices of spatial segregation

Among the many methodologies used to quantify residential segregation are the segregation indices, which have been used since the 1950s. There is a wide variety of indices that are based on different theoretical conceptions of what constitutes a situation of segregation (Massey; Denton, 1988; Reardon; O'sullivan, 2004), among which the most popular are the dissimilarity, isolation and exposure indices. There is broad agreement in the literature that segregation should be characterized by more than one index and that they capture different spatial dimensions of the phenomenon. According to Reardon and O'Sullivan (2004), segregation can be captured via two spatial dimensions: (i) evenness/clustering and (ii) isolation/exposure. While the first portrays the geographic distribution of population groups in urban space, the second characterizes the potential for interaction between members of different population groups, based on the notion of spatial proximity.

In this study, the evenness/clustering dimension is represented by the index of Dissimilarity, while the isolation/exposure dimension is characterized by the indexes of the same name. Each index represents a different facet of segregation and, when analyzed together, they provide a comprehensive characterization of the phenomenon.

The Exposure index refers to the potential contact between members of two different population groups, considering that one member of a population group shares a given urban area (locality) with members of another group (exposure) (Bell, 1954). Thus, it is assumed that individuals residing in the same geographic area are more likely to have contact with each other. For the Exposure index, a situation of segregation is demonstrated through low exposure between members of different groups (m,n). The Isolation index constitutes a special exposure situation, which captures the potential contact between people belonging to the same population group (m,m) sharing a certain area (locality). In this case, a situation of high segregation for the group is indicated by high isolation values.

The index of Dissimilarity (D), in turn, is based on the idea that a situation of "segregation" is characterized by the unequal spatial distribution of different population groups (Cortese; Falk; Cohen, 1976). This index was originally operationalized through a measure that computes the proportion of members of a given population group who must be displaced so that there is a homogeneous spatial distribution between two population groups (Duncan; Duncan, 1955). The index was later adapted to provide an analysis of segregation for multiple population groups, called the Generalized Index of Dissimilarity (Dm) (Sakoda, 1981).

In this paper, the Generalized Index of Dissimilarity is adopted to represent the evenness/clustering dimension and the Normalized Indices of Exposure and Isolation for the isolation/exposure dimension. The Normalized Index of Exposure/isolation (Feitosa et al., 2021) was selected because, through an additional term, it deals with changes in the proportions of population groups that can cause problems for comparative studies.

It is important to highlight that the versions of the segregation indices adopted in this paper are spatial, as proposed by Feitosa et al. (2007). Spatial indices were developed in response to a limitation of non-spatial indices in reflecting differences in the spatial configuration of the distribution of groups in their global values. This limitation was first documented by White (1983), based on the hypothetical "checkerboard problem", in which the index of Dissimilarity produced the same result for different spatial configurations between two population groups. Since then, several proposals have emerged for the spatialization of different segregation indices (Feitosa et al., 2007; Jakubs, 1981; O'sullivan; Wong, 2007; Reardon; O'sullivan, 2004; Wong, 2003; 2005).

Feitosa et al. (2007) developed spatial versions of the Dissimilarity, Exposure and Isolation indices based on the concepts of "locality" and "local population intensity". The main idea is that urban areas are made up of different locations,

which constitute “places where people live and exchange experiences with their neighbors” (Feitosa et al., p. 302). It is assumed, therefore, that the interactions that occur within it are more intense than those that take place across different locations. In operational terms, a Gaussian kernel intensity estimator is placed at the centroid of the reference area unit (census sector) and a composite population count is performed, which is a geographically weighted average defined by a decay function as the distance increases (id., ibid.). Variations in the bandwidth parameter allow analyzes at different geographic scales (id., ibid.).

Formally, population intensity (L_j)is calculated by:

$$\check{L}_J = \sum_{j=1}^{J} k\ (N_j) \quad (1)$$

where: N_j is the total population in the unit area j; J is the total number of units in the study area; k is the kernel estimator that defines the influence of each area unit in location j.

The population intensity of group m in location (L_{jm}) is expressed as follows (Feitosa et al., 2007):

$$\check{L}_{jm} = \sum_{j=1}^{J} k\ (N_{jm}) \quad (2)$$

where: N_{jm} represents the number of individuals in group m in area j; j is the total number of units in the study area; k is the proximity function that defines neighborhood j.

Feitosa et al. (2007) also highlight the difference in the roles of the global indices, which summarize the level of segregation in a single value, and local indices, which decompose the global index and can demonstrate, through choropleth maps, how each location contributes to the global index (id., ibid.) and, thus, enable spatial patterns of segregation to be explored.

In the global version, the Generalized Index of Dissimilarity presents values between 0 (maximum integration) and 1 (maximum segregation). The values are higher when the locations have a disproportionate distribution of different population groups in relation to the city as a whole. With regard to the values of the Normalized Exposure Index, a situation of integration is represented by a value of 1 (where the probability of members from two different population groups sharing the same location is equal to the size of the population groups); lower or higher values represent a situation of segregation. In the case of the Normalized Isolation Index, values higher or lower than 1 indicate greater or lower i isolation than expected in an integrated location. For example, a value of 2 referring to the isolation of group A signifies that it is twice as segregated as expected in an integrated distribution.

Adopting spatial indices that use a kernel function enables the comparison of segregation across different periods, minimizing methodological problems arising from the use of different sizes of data aggregation units (Wong, 1997). In addition, since the scale of analysis is determined by the bandwidth used in the calculation, adopting different bandwidth parameters in the kernel function also enables multiscalar analyses. To compare changes in segregation on multiple scales, global and local spatial segregation indices were applied for the years 2000 and 2010. The employed bandwidths ranged from 800 m to 2000 m and were computed for every 200 m. The 2000 m scale was adopted as the most comprehensive, representing trips that require a means of transport, while the 800 m bandwidth was used to represent a local scale, using a distance that could be covered on foot.

For a comparative analysis of global spatial indices computed for different bandwidths, segregation profiles were adopted, a term used by Reardon et al. (2008) for graphs that compare segregation rates between scales. These tend to present decreasing values as the scale increases. The greater the geographical area, the higher the population count and diversity of population groups tends to be. The slope of the profile, however, indicates at which scale segregation is most evident and significant. While profiles with a flatter trend indicate predominant macro-patterns, steeper profiles demonstrate a greater predominance of segregation micro-patterns (id., ibid.).

3.2. Socio-economic groups in medium-sized cities in the state of São Paulo

This study focuses on residential segregation from a socioeconomic perspective, using income groups as a proxy for socioeconomic groups. Income is a readily available variable in the smallest aggregation unit of the Brazilian Census (census tracts) and for several census periods, which is why it is one of the most used variables to portray socioeconomic levels in Brazil (see Feitosa et al., 2007; França, 2016; Oliveira; Silveira Neto, 2015; Telles, 1995; Ywata et al., 2011). However, income variables may present a comparability problem over time, since the unit of monetary values tends to be volatile to economic changes and may also vary between study areas (Reardon et al., 2008).

In order to avoid this problem and enable comparison between data from two different periods, the harmonization methodology proposed by Araujo et al. (2023) has been adopted. The methodology involves reclassifying variables aggregated by the minimum wage (MW) of the 2010 Census, using the 2000 MW as a reference, corrected for inflation, to the detriment of using the MW established for 2010. Table 1 presents the population groups adopted and classified by income bracket. The proportion of groups in 2000 and 2010 for each city is presented in Figure 2.

Income bracket (MW in 2000 and the MW adjusted for 2010)	Population Group
Above 20	A
Between 10 and 20	B
Between 5 and 10	C
Between 2 and 5	D
Up to 2	E

Table 1. Population groups per income of the head of the household
Source: Classification by the authors (2023) based on IBGE (2000; 2010) data.

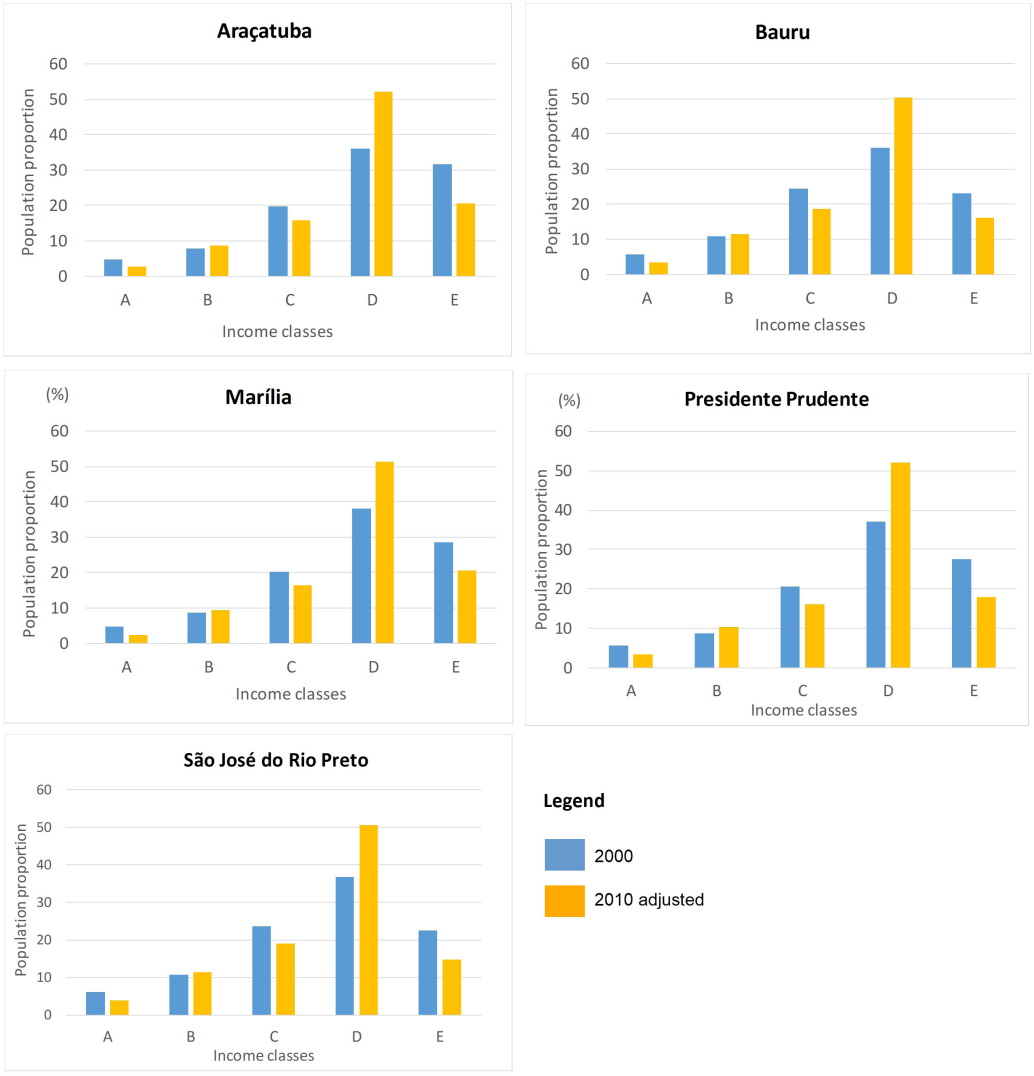

Figure 2. Population composition per income class in 2000 and 2010
Source: The authors (2023) based on IBGE (2000; 2010) data.

The population composition resulting from the adjusted classification demonstrates a significant increase in the proportion of class D (2 to 5 MW) in all study areas, as well as a sharp drop in the proportions of income classes E (up to 2 MW), reflecting the decrease in poverty that occurred during this decade. Concerning the higher income groups, there is a small increase in the proportion of class B (from 10 to 20 MW), accompanied by a decrease in class A (above 20 MW).

4. Results and discussion

The results of the global Generalized Spatial Index of Dissimilarity (Dm), at different scales for the five medium-sized cities, are presented in Figure 3. An increase in dissimilarity between the 2000 and 2010 can be observed for all cities, with the exception of Araçatuba, which retained its index values. The profiles also reveal different scalar patterns of segregation in the evenness/clustering dimension. Comparatively, Bauru and São José do Rio Preto present higher dissimilarity values, while Araçatuba presents the lowest. Bauru, however, exhibits a slightly higher dissimilarity than São José do Rio Preto on the micro-scale, while on the macro-scale this trend becomes reversed. This pattern can be observed for both 2000 and 2010. When contrasting Marília and Presidente Prudente, it can be noted that, in 2000, Marília presented a greater dissimilarity on the micro-scale, while in 2010, the values were the same for both cities. On the macro-scale, Marília remained more dissimilar than Presidente Prudente.

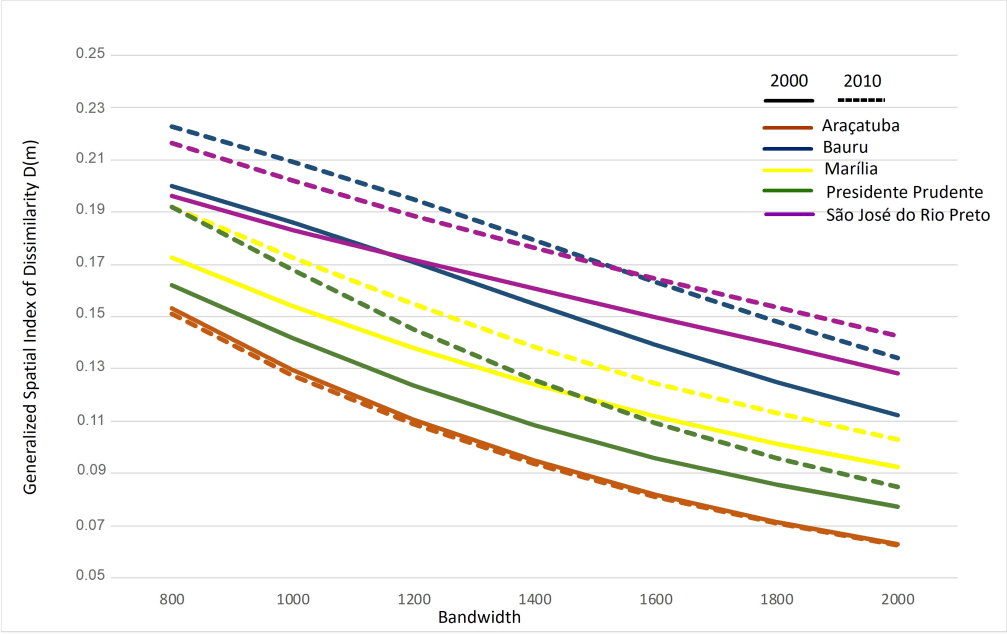

Figure 3. Segregation profiles – the Global Generalized Spatial Index of Dissimilarity
Source: The authors (2023).

The maps in Figure 4 illustrate the most dissimilar locations and complement the analysis of the global results, enabling an analysis of the extent to which the spatial arrangement of population groups contributes to the results of the global indices. Figure 4 presents three sets of maps, one for each period analyzed and a third classifying each census tract according to the difference/change between the two periods.

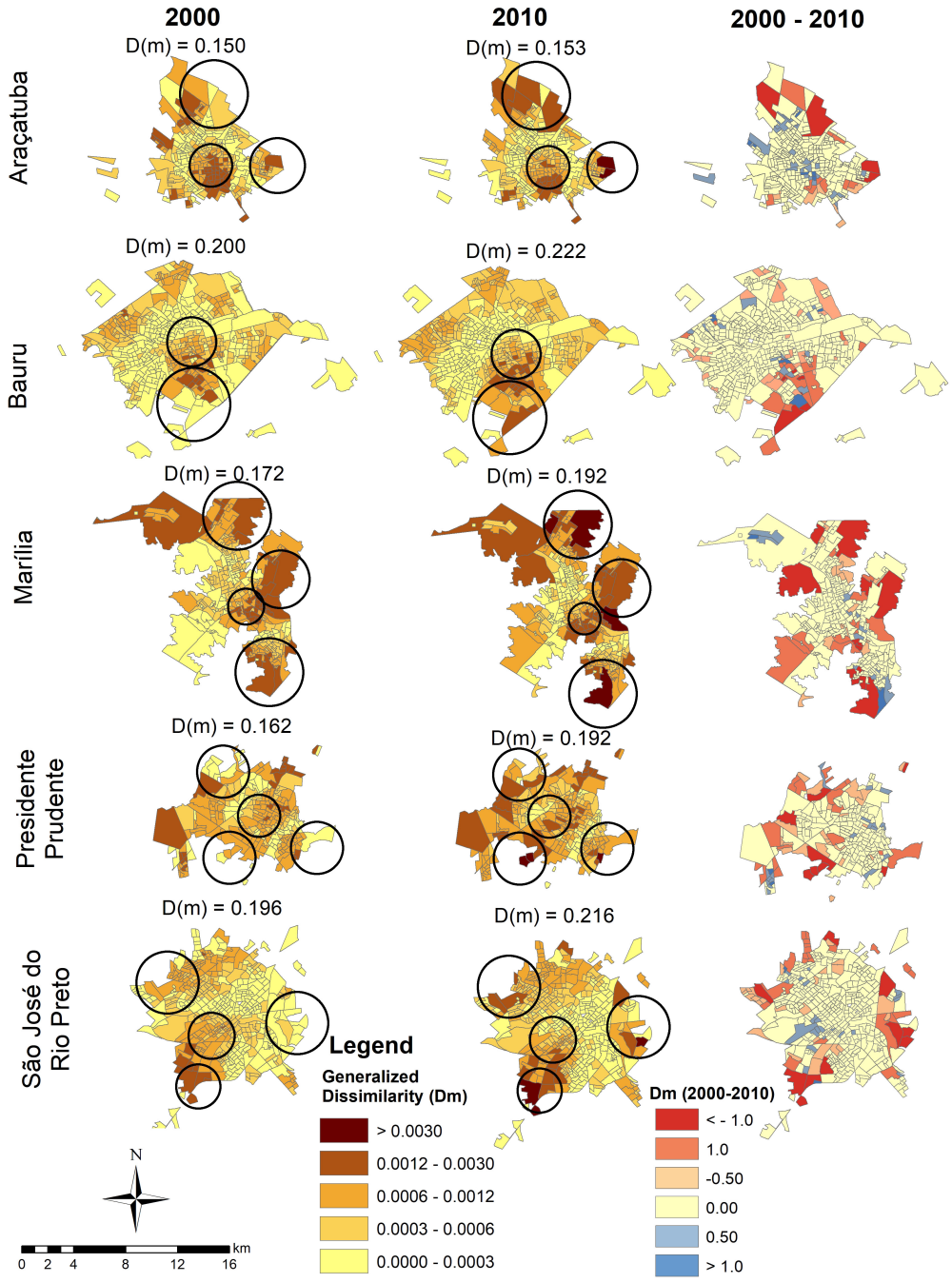

Figure 4. Local Generalized Spatial Index of Dissimilarity (800 m bandwidth)
Source: The authors (2023) based on IBGE (2000; 2010) data.

The peripheries presented complex trends, with an increase in dissimilarity in 2010 in the five medium-sized cities in the state of São Paulo (locations in shades of red). Occasionally, some peripheral locations (in shades of blue) can be observed in the five medium-sized cities, where there was also a reduction in the index values. These results are consistent with other studies that discuss how the peripheries in medium-sized cities in the state of São Paulo have become more complex and fragmented (Sposito, 2004; Sposito; Góes, 2013).

An increase in dissimilarity can also be observed in vectors toward specific directions in each of the five cities (in shades of red). In Marília and Araçatuba, the increase occurs in the east-central direction; in Bauru, São José do Rio Preto and Presidente Prudente, in the south-central direction. The increase in dissimilarity in these areas coincides with the locations where there was also an increase in group A isolation (Figure 6).

In the most central locations (see circles in the maps in Figure 4), there was a reduction in dissimilarity during the period (shades of blue) in all cities. These results can be understood in light of changes in the center-periphery pattern in medium-sized cities during the early 2000s, when the development of enclosed residential spaces, together with new consumption spaces for the high and middle socioeconomic groups (shopping centers), resulted in these groups moving out of residential neighborhoods close to the main center which they had traditionally occupied (Sposito, 2004).

The results of the Normalized Global Spatial Isolation Indices complement the dissimilarity analysis. The isolation profiles of group A (very high income), presented in Figure 5, demonstrate an increase in the isolation of this group in all cities during the period, considering the local scale. Marília and Bauru demonstrated a significantly greater increase in group A isolation in 2010 compared to the other cities.

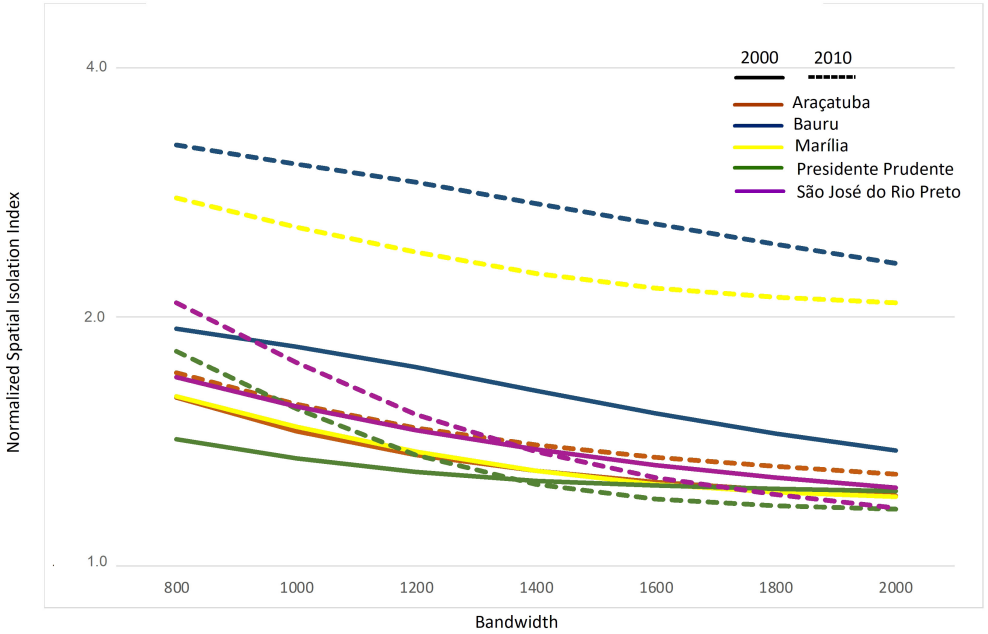

Figure 5. Normalized Global Spatial Isolation Index (group A)
Source: The authors (2023).

In São José do Rio Preto and Presidente Prudente, it can be observed that, from the 1,400 m scale onwards, group A is less isolated in 2010 than in 2000. This trend was widely discussed by Caldeira (2000), who stated that, while enclosed residential spaces accentuated the physical (geographic) proximity between socioeconomic groups, maintain social distance through walls and security equipment. This pattern, however, is not observed in all the cities analyzed. The flat trend in the profiles of Marília and Bauru in 2010 indicates that group A remained isolated on all scales in these cities.

Such results are related to an increase in dissimilarity (Figures 3 and 4). The very slight increase in the isolation of group A on all scales, in Araçatuba, did not significantly impact the values of the dissimilarity index. However, Marília and Bauru, which recorded a more notable increase in group A isolation, also demonstrated a greater increase in dissimilarity. Presidente Prudente, which presented a decline in group A isolation on the macro-scale, exhibited a less significant increase in dissimilarity on the same scale.

The local spatial indices that characterize the isolation of group A (Figure 6) complement the interpretation of the result of the global spatial index. In 2010, in all 5 cities, there was an increase in locations with high isolation of the group A in peripheral areas (shades of red). Presidente Prudente and Araçatuba presented

this trend with less intensity (lighter shades of red), since the isolation values for this group, despite having increased in 2010, did not increase to the same levels of Bauru, Marília and São José do Rio Preto.

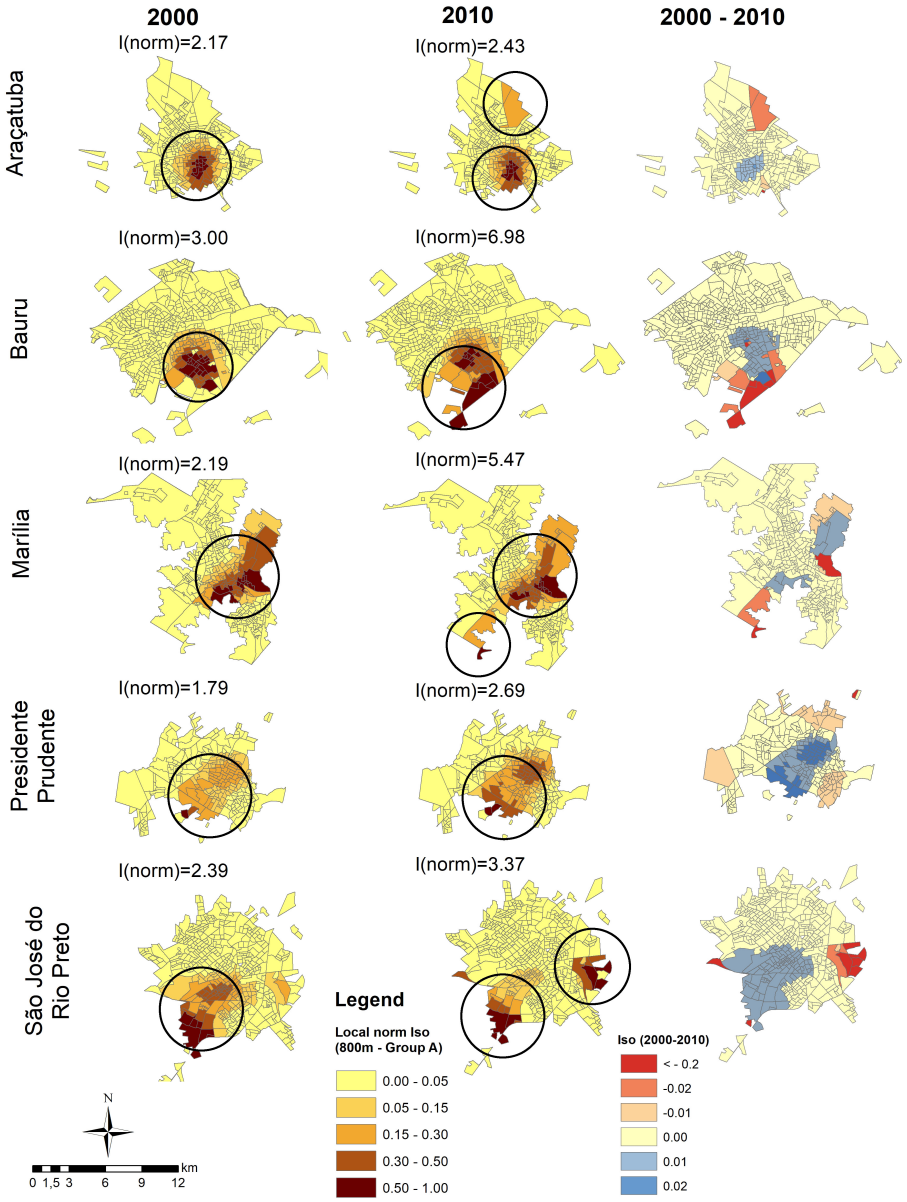

Figure 6. Normalized Local Spatial Isolation Index (grupo A) – 800 m bandwidth
Source: The authors (2023) based on IBGE (2000; 2010) data.

An increase in group A isolation in 2010 in São José do Rio Preto and Presidente Prudente occurred in areas where, in 2000low-income groups were predominant (Figure 8). This fact explains the tendency for the segregation profiles

of these cities (Figure 5), to present less isolation in 2010 than in 2000 on a scale of 1,400 m. Inversely, in Bauru and Marília, the increase in group A isolation occurred in sectors where high-income groups already predominated, resulting in a sharp increase in the isolation of this group on all scales, as observed in Figure 5.

The increase in group A isolation is associated with the development of high and middle-end enclosed residential spaces in these same locations. In Araçatuba, the increase occurred in a specific peripheral location, in which five new high-end enclosed residential spaces were allocated between 2000 and 2010. Magrini (2011) mapped these residential developments in Araçatuba and highlighted their adjacency to two low-income housing complexes also launched during this period.

In São José do Rio Preto the locations that registered an increase in isolation of group A coincided with the development of enclosed residential spaces. According to Barroso (2010), 26 enclosed residential spaces were developed in São José do Rio Preto, mostly concentrated in the eastern side of the city. In Bauru, there were nine high-end developments, concentrated in the south-central region in a corridor-like pattern along Avenida das Nações Unidas (Coimbra, 2018). Dal Pozzo (2013) indicated that the enclosed residential spaces developed in Marília and Presidente Prudente are concentrated, respectively, in the east and south regions. The author also mentioned that the distance between high-end developments and residential neighborhoods, where other population groups predominate, is accentuated in Marília due to some of the natural characteristics of the urban site, such as heavily festooned cliffs (Dal Pozzo, 2013).

The central areas of all the cities analyzed (Figure 6) presented a reduction in the isolation of group A (shades of blue), which indicates how the central residential neighborhoods, traditionally occupied by very high-income classes, have changed their profile following the move of high-income groups toward peripheral areas. The more central areas have thus become more heterogeneous with a greater presence of other socioeconomic groups.

The isolation of group E, the lowest income group (Figure 7), presented a slight increase in 2010 in all five medium-sized cities on all scales. In Araçatuba, this increase was very slight at the micro-scale. A similar trend can be observed at the macro-scale for Presidente Prudente and Marília. Conversely, São José do Rio Preto and Bauru displayed a more substantial increase in the isolation of group E across all scales.

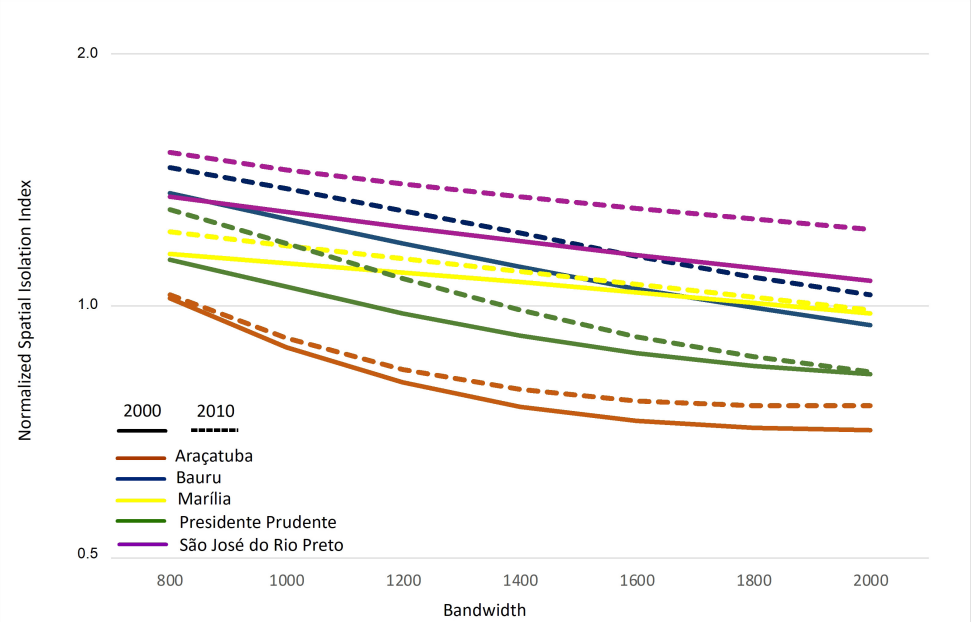

Figure 7. Normalized Global Spatial Isolation Index (group E)
Source: The authors (2023).

Observing the local indices for group E (Figure 8), it can be noted that, in Araçatuba, Bauru, Marília and Presidente Prudente, the increase occurred in specific peripheral locations (areas in shades of red). This suggests the ongoing peripheralization of this group. In São José do Rio Preto, the increase in isolation of group E is more widespread across the city, except for areas concentrated with the elite (eastern sectors) and the central area. These areas also correspond to those where there was an increase in dissimilarity (evenness/clustering dimension), as seen in Figure 4. This particularity in the spatial patterns of São José do Rio Preto is aligned with a predominance of the low-income population in the northern area, as indicated by Coimbra (2018) and Petisco (2007), where there is also a higher number of informal settlements. The city's singularity lies in its greater spatial selectivity and in its reduced supply of social housing complexes when compared to Bauru, for example (Coimbra, 2018). This fact provides insights for grasping the dispersion pattern of isolation within group E in São José do Rio Preto.

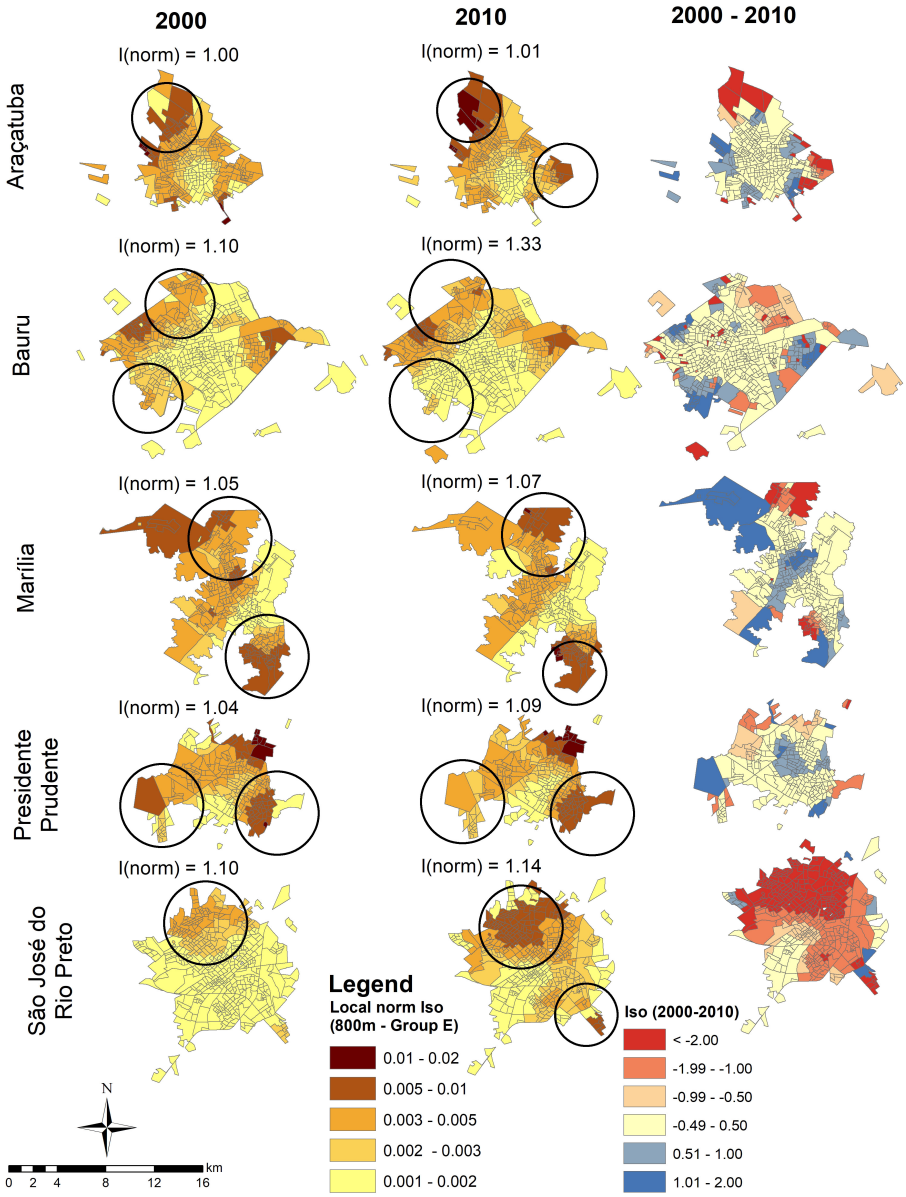

Figure 8. Normalized Local Spatial Isolation Index (group E) – 800 m bandwidth
Source: The authors (2023) based on IBGE (2000; 2010) data.

The exposure/isolation matrix, presented in Figure 9, describes the results for the Normalized Spatial Indices of Exposure and Isolation, computed for the five medium-sized cities. Exposure was calculated for each pair of income group, with the exposure of one group to itself presented as the Isolation (diagonal). The lower corner of the matrix contains the values for 2000 and the upper corner, those for 2010. As previously mentioned, values close to 1 indicate integration between the groups, while values lower and higher than 1 indicate a greater and lesser

exposure, respectively, than expected in an integrated region. As expected, the Normalized Spatial Exposure Index presents values lower than 1 for groups whose income levels are furthest apart (groups A and E) and higher than 1 for those that are closer (groups A and B).

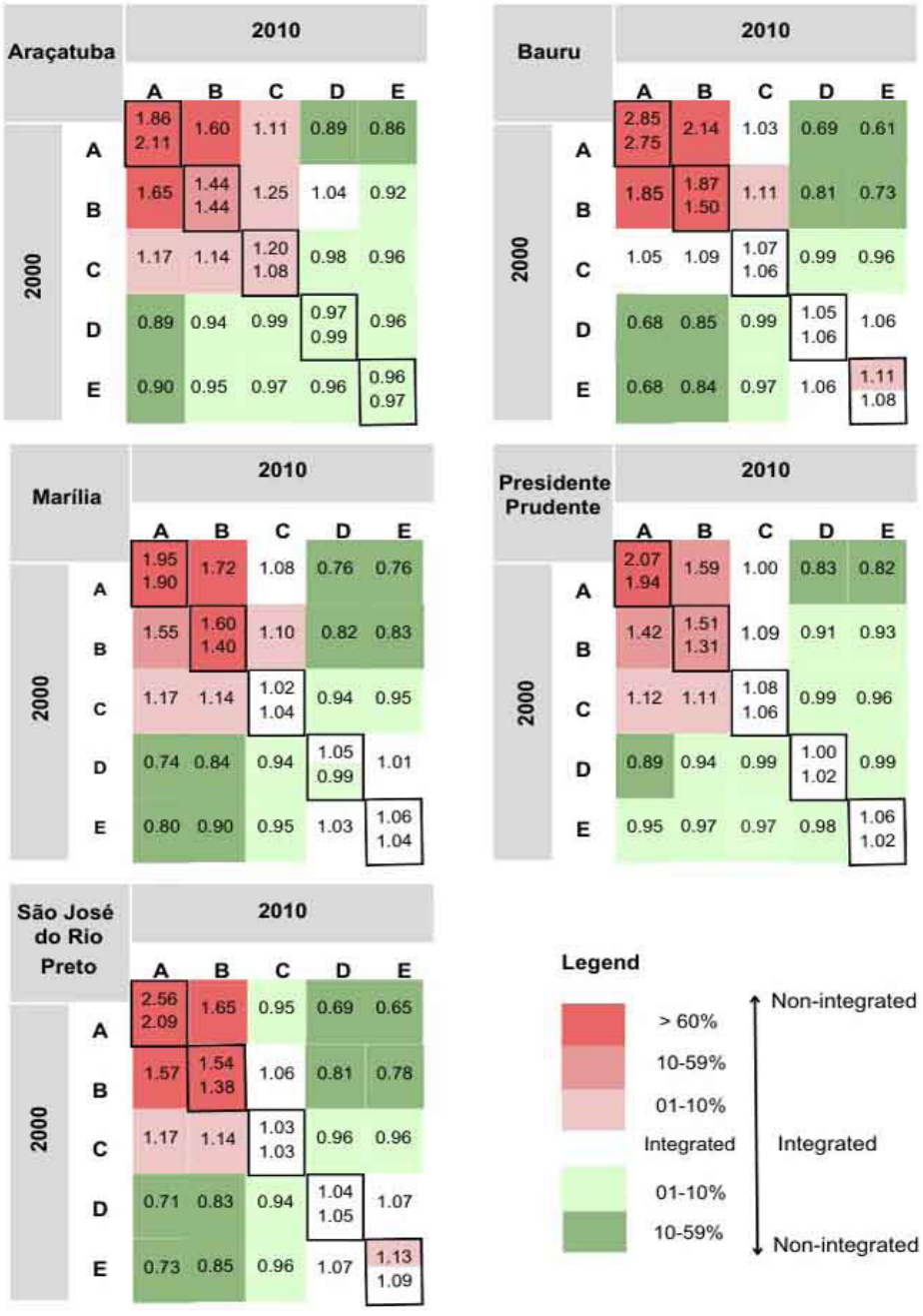

Figure 9. Exposure/isolation matrix of all population groups, computed for the 1,000 m bandwidth – 2000 (bottom left) and 2010 (top right)

Source: The authors (2023) based on IBGE (2000; 2010) data.

The overarching trend noted from 2000 to 2010 indicates integration among the nearest income groups (A and B) and diminished exposure between the classes with greater disparity (A and E). The matrix presents a reduction in the exposure of groups A and E in all cities, on this scale (shades of dark green). Bauru, Presidente Prudente and São José do Rio Preto presented the greatest reduction, with a drop of 0.08 in the index (from 0.68 to 0.60 for Bauru, from 0.90 to 0.82 for Presidente Prudente and from 0.73 to 0.65 for São José do Rio Preto), followed by a reduction of 0.08 for Marília and 0.04 for Araçatuba (respectively, from 0.80 to 0.76 and from 0.90 to 0.86). The results therefore indicate that, in 2010, these groups became less exposed to one another.

The matrix also reveals that groups A and E presented higher isolation in 2010 in all cities, except for Araçatuba, which demonstrated reduced isolation in group A (from 2.11 to 1.86). This fact is consistent with a greater proximity of groups A and E in Araçatuba, given the development of high-end enclosed residential spaces near social housing complexes in the northern region of the city (Magrini, 2013). It can also be observed that all cities – except Araçatuba – revealed an increase in exposure between groups A and B in 2010.

During the period, exposure between groups D and E remained stable in three of the five cities. Araçatuba, Bauru and São José do Rio Preto presented constant values (0.96, 1.06 and 1.07, respectively). In Marília and Presidente Prudente, however, there was a slight increase in exposure among these groups.

Upon analyzing the combined results, it is clear that in 2010 there was an increase in segregation within the dimensions of evenness/clustering and isolation/exposure in four out of the five medium-sized cities under examination. This increase was particularly pronounced at the micro-scale. Notably, Bauru and Marília stand out for experiencing a substantial rise in isolation for both the highest and lowest income groups, accompanied by a relatively smaller increase in the evenness/clustering dimension. Araçatuba, on the other hand, exhibited a tendency to uphold existing patterns, with only a slight uptick in the isolation of groups A and E.

Bauru and São José do Rio Preto, for instance, experienced urban growth by assimilating irregular lots between 1960 and 1980. In contrast, Marília and Presidente Prudente expanded their urban areas by incorporating rural spaces, facilitated by a collaboration between landowners and public authorities. Subsequently, both cities transitioned to a business approach in the process of land incorporation (Boscariol, 2017; Coimbra, 2018; Sposito, 1983). These processes generated a predominance of macro patterns of segregation in the first cities and micro patterns in the second. Araçatuba, on the other hand, the process of land incorporation started earlier,

in 1950, which generated fewer vacant land (Boscariol, 2017), thus enhancing the resilience of the city's segregation patterns. This observation aligns with Leme's (1999) findings concerning vacant urban land, which suggests it is linked to non-spontaneous value appreciation processes vulnerable to real estate speculation.

In all the medium-sized cities analyzed the peripheries presented a dual trend: a global increase in segregation between 2000 and 2010, with a reduction in segregation in specific scattered locations. The results demonstrated an increase in the isolation of the lowest-income group (group E) and the highest-income group (group A) on the peripheries. These findings are in line with the literature, which has discussed that peripheries have become more complex and fragmented, even in medium-sized cities (Sposito, 2004, Sposito; Góes, 2013). Moreover, the findings contribute with empirical evidence to discussions raised in previous studies, emphasizing that the increased presence of high-income groups in peripheral areas does not necessarily indicate a reduction in segregation levels. Instead, it suggests a shift in the scale of segregation, maintained at micro level (Feitosa et al., 2021).

Within all five medium-sized cities, the most segregated group was group A. In Marília and Bauru, there was an aggravating factor: the increased isolation of this group occurred in sectors where there was a previous predomination of middle and high socioeconomic groups, which exacerbated their isolation in 2010. This pattern is in line with research results that suggest a process of uneven appreciation in peripheral areas, occurring selectively and intentionally in specific directions (Melazzo, 2013; 2015). The low-income group (group E) demonstrated an increase in isolation on the outskirts of urban expansion in a discontinuous fashion, indicating the persistent trend of peripheralization of low-income groups – a trend also noted in the metropolis of São Paulo (Feitosa et al., 2021). The decrease in segregation in specific areas can be related to the introduction of enclosed residential spaces for higher and middle-income groups on the peripheries, where the low-income population is also present, albeit to a lesser degree.

5. Conclusions

The spatial segregation indices applied to Araçatuba, Bauru, Marília, Presidente Prudente and São José do Rio Preto have indicated an increase in segregation in both spatial dimensions (evenness/clustering and isolation/exposure) in four of the five cities analyzed, and in Araçatuba the existing patterns were maintained. In all five medium-sized cities, the most segregated group was the high-income group (more than 20 MW, group A). This increase between 2000 and 2010 is associated with the development of middle and high-end enclosed

residential spaces in specific sectors of medium-sized cities in the state of São Paulo (Sposito, 2006), whose locations coincide with the increase in question (Barroso, 2010; Coimbra, 2018; Dal Pozzo, 2013; Magrini, 2013).

This trend was also observed in the São Paulo metropolis during the same period (Feitosa et al., 2021; França, 2016; Marques, 2016). In addition, the results have revealed a continuity of the peripheralization processes of the lowest income group (up to 2 MW, group E) between 2000 and 2010. The spatial pattern, unlike the elites, is more dispersed throughout the peripheries, on the fringes of urban growth. Furthermore, the results have also demonstrated a characteristic process of medium-sized cities, which is the reduction of segregation in central areas. This trend suggests shifts in center-periphery dynamics in medium-sized cities, propelled by the emergence of enclosed residential areas and new spaces of consumption catering to high and middle socioeconomic populations (shopping centers) (Sposito, 2004). As a result, there has been a transformation of traditional elite residential neighborhoods at city centers, which are more heterogeneous.

Between 2000 and 2010, a series of substantial economic and political changes occurred at the national level, contributing to a decrease in social inequalities (Marques, 2014). However, these factors did not translate into a reduction of segregation in medium-sized cities in the state of São Paulo. On the contrary, the findings presented in this paper indicate an increase in segregation during this period. The processes of disruption in the center-periphery pattern persisted, resulting in a spatial reconfiguration characterized by heightened and more intricate social isolation, particularly in peripheral areas. Despite these changes, historical patterns exhibit remarkable resilience, as exemplified by the case of Araçatuba.

The paper has demonstrated that an increase in segregation between 2000 and 2010 did not only occur in metropolitan regions (see Feitosa et al., 2021; França, 2016; Marques, 2016), suggesting that segregation is also intrinsic to the (re)production process space urbanization in medium-sized cities in the state of São Paulo. This indicates the need for public policies aimed at addressing residential segregation as an ongoing urban dynamic inherent in Brazilian cities, encompassing both metropolises and medium-sized cities.

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Agnes Silva Araujo

Holds a bachelor's and licentiate degree in geography (2013), a master's degree (2015) and doctorate in physical geography (2020) from the Universidade de São Paulo (USP). She has experience in the area of urban and regional planning with particular emphasis on the representations of complex urban phenomena. She is currently a professor on the postgraduate course in urban management (PPGTU) at the Pontifícia Universidade Católica do Paraná (PUCPR).

Email: agnes.araujo@pucpr.br

ORCID: 0000-0002-1449-8984

Authorship contribution: Conception; Data Curation; Formal Analysis; Methodology; Visualization; Writing – First Draft; Writing – Review and Editing.

Joana Barros

Holds a PhD from the Center for Advanced Spatial Analysis (CASA) at University College London (UCL), where she is currently a research associate. She specializes in the use of geospatial techniques and data for the study of urban inequalities, with particular experience in segregation, urban growth, housing and informal settlements, and transport.

Email: j.barros@ucl.ac.uk

ORCID: 0000-0001-7796-9774

Authorship contribution: Conception; Formal Analysis; Methodology; Supervision; Writing – First Draft; Writing – Review and Editing.

Marcus Vinícius Pereira Saraiva

Holds a bachelor's degree (2010) and master's degree (2013) in architecture and urban planning from the Universidade Federal de Pelotas (UFPel), and a doctorate (2020) in geographic information science from Birkbeck, University of London. He is currently a data scientist at Petrobras. His research focuses on the problems of inequality in accessing opportunities and spatial segregation in cities, using modeling and computer simulation techniques of urban systems.

Email: m.saraiva@mail.bbk.ac.uk

ORCID: 0000-0001-6218-2338

Authorship contribution: Conception; Data Curation; Formal Analysis; Writing – First Draft.

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