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Urban transformations: Towards resilient cities

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Paper Title: Mapping intra-urban food insecurity vulnerability in the São Paulo Metropolitan Region, Brazil.

Session number:

☐ 1. Cities as a resilient system: between processes and actions
☒ 2. Local and Urban Governance: lessons from the past and prospects for resilient and sustainable development in a time of global emergencies and transitions
☐ 3. Tourism as a driver of urban change in post-pandemic cities
☐ 4. From urban geo-diversity to Geo-tourism: Themes, links and interactions
☐ 5. Migration and the Resilience of Cities
☐ 6. Public policies "up to down" and "bottom up" in the face of climate change

EXTENDED ABSTRACT:

a) 1-2 pages in general

b) 6 pages for the application to the Early Career Researcher award of IGU Urban Geography Commission *(Early career researchers are considered before PhD completion or within 5 years after)*

• Theoretical background

Household income is the most important variable to explain access to food [1][2], but there are also macro-socioeconomic, regional, local as well as household determinants that are associated with FI status [3]. From the standpoint of socioeconomic access to food, studies have shown that moderate and severe Food Insecurity (FI) increases when there is a higher presence of children [4], lack of regular and permanent access to treated water [1][5], higher household density [4], households headed by women [2][4][6][7], by blacks [2][4][8], by people with low education [8][7][9] [10] and, in a condition of unemployment or informal employment [10]. From the perspective of physical access to food, the presence of food deserts [11][12] and food swamps [13], characterize a poor-quality food environment and may limit an adequate diet. The consequences of hunger and malnutrition, when chronic, produce negative health impacts ranging from childhood [7][14][15][16] to adolescence and youth [17] lasting into adulthood [18][19].

In Brazil, studies that measure FI are built from sample surveys and are available on large territorial scales (national, regional, and state levels), and is impossible to disaggregate the results to intra-urban scales. Aiming at the design of more targeted and effective public policies, the current research presents the first results of a methodology proposed for the identification of the gradations of vulnerability to FI, in 2010, at the intra-urban scale for the 39 municipalities of the Metropolitan Region of São Paulo (MRSP).

• Research questions

This research aims to answer two main questions: i) is FI vulnerability homogeneously distributed in the 39 municipalities that formed the MRSP? and, ii) are the areas classified as slums homogeneous spaces of FI or are there differences among them?

• Methodology

To answer these questions, two indicators were constructed. The first one (built at the enumeration area scale in the intraurban area) was called Food Access Indicator (FA) and characterized by FI determinants composed of socioeconomic and physical access variables and by health-negative results associated with FI. The FAI was composed of nine variables, distributed in three dimensions: i) socioeconomic access to food (data from the 2010 demographic census) was composed of proportion of no-white people, proportion of children under the age of 15, proportion of literate women aged 60 or older, proportion of dwellers with access to treated water, income per capita and dwellers per bathroom; ii) physical access to food, (from the Annual Social Information Report of the Ministry of Labour) composed of distance[1] from mixed establishments that commercialize "in natura" food and processed food (such as supermarkets and restaurants) and distance from establishments that commercialize “in natura” food (such as butchers, fishmongers, and horticulturists); and, iii) public hospitalization rate for diseases related to FI, as thyroid disorders related to iodine deficiency, nanism, malnutrition, vitamin A deficiency, other vitamin deficiencies, sequels of malnutrition and other nutritional deficiencies, and obesity. The data were combined with Principal Component Analysis (PCA), using the varimax method, which transformed the nine variables into three principal components, with eigenvalues above one. To construct a unique indicator, the results for which component in which the enumeration area was normalized (resulting in values from 0 to 1) and weights were assigned, according to the proportion of the total variance explained by the model. The result for which component was multiplied by 10. In this way, the FA resulted in values between 0 and 10, where

[1] For the calculation of distance, in all cases, the same procedures were adopted. For example, establishments that commercialize food were spatialized as points. Using Qgis, the Voronoi polygon was generated. Voronoi polygons divide a given space into regions, where each region is formed by the points closest to a given generating point (in the example, the establishments). From this, the area of each region was calculated. Each element of the enumeration area grid (or the statistical grid, in the case of the addresses of the schools, primary health care units, etc) was identified to the Voronoi polygon to which it belongs. It was considered that the smaller the area of a region, the greater the supply of establishments, in the opposite direction, the larger the area, the smaller the supply.

values closer to 0 meant better access conditions, while those closer to 10 meant the opposite condition.

The second indicator (constructed in the statistical grid) was named Urban Integration Indicator (UI) aims to characterize the degree of public investments that can impact the FI on an intraurban scale considering the entire metropolitan area. The UI combined 10 variables from four dimensions: i) urban infrastructure, the proportion of dwellers without access to sewer; ii) access to government equipment, composed of five indicators that measure the distance to public day-care centers (0 to 3 years old), public kindergartens (4 to 5 years old), public elementary schools and middle schools (6 to 14 years old), primary health care units, and distance from social support centers; iii) public supply, distance to street markets and distance to public restaurants, municipal markets, and food banks; and, iv) mobility, distance to the access stations to metropolitan and local transportation, formed by trains, subways, and bus corridors. The values for each variable were normalized (0 to 1). Then all variables were summed, and the result ranged from 0 to 10, with values close to 0 being better urban integration, while values close to 10 mean worse conditions. These two indicators, spatialized in terciles and statistical grid scale, when overlapped, resulted in the Food Insecurity Vulnerability Index in the São Paulo Metropolitan Region. The results indicated nine degrees of vulnerability to food insecurity. To answer the two questions proposed as objectives of the article, the amount of population living in each of these degrees was calculated, aggregated both at the municipal level and at the slum level, using the slum boundaries available by the Brazilian Institute of Geography and Statistics [20].

• **Results/findings**

In 2010, this region had 18,766 million residents in urban areas. According to the proposed methodology, almost 4,291 million urban residents lived with low access to food and 1,782 million residents lived in localities with low urban integration. The two overlapping indicators resulted in 1,239 million residents with low access to food and low urban integration combined, and these should be considered potential priorities for actions that aimed to combat hunger. Figure 2 shows that the best and worst vulnerabilities of FI are not equally distributed among all municipalities that form the MRSP. In the MRSP 31 municipalities have slums recognized by official agencies, and, in 2010, there were almost 1.9 million inhabitants in these settlements. Of this total, less than 0.5% (just over eight thousand people) lived with a high degree of access to food and a high degree of urban integration. Possibly, these people lived on the edges of the slums and the pixel size of the statistical grid ended up homogenizing census sectors with very different conditions. On the other hand, almost 283,000 people (15% of the total number of slum residents) lived in situations of low access to food and low urban integration. The city of São Paulo's slums, which concentrated almost 1.160 million inhabitants (61% of MRSP total), had 164 thousand people in this condition. The graph in Figure 3 presents the distribution, by the municipality, of the population residing in slums with the worst degree of vulnerability to IA (dark color), in relation to the total population in slums. Municipalities with a small population and with less than three thousand slum residents had 100% of the population in these settlements in the worst degree of FI vulnerability.

• **Significant/general conclusions**

The proposed index is based on the premise that the socioeconomic condition is not limited to individual or family group income but is supported by other inequalities that are marked by racial, demographic, housing condition, and location of residence (which conditions physical access to food stores with nutritional quality). On the other hand, it is considered that public investments in a region, also living close to public establishments of education, health, and social assistance, as well as other forms of actions and equipment destined for food supply (such as public markets and street fairs) can differentiate groups of people who, despite being very similar from the socioeconomic point of view, are spatially in greater or lesser vulnerability to food insecurity.

The proposed indicators aim to contribute to more effective actions orchestrated by the public authorities to reduce social inequalities. In this sense, it is understood that in metropolitan contexts, such as the RMSP, whose municipalities have great interdependence, the actions aimed at reducing inequalities need to be solved based on common governance.

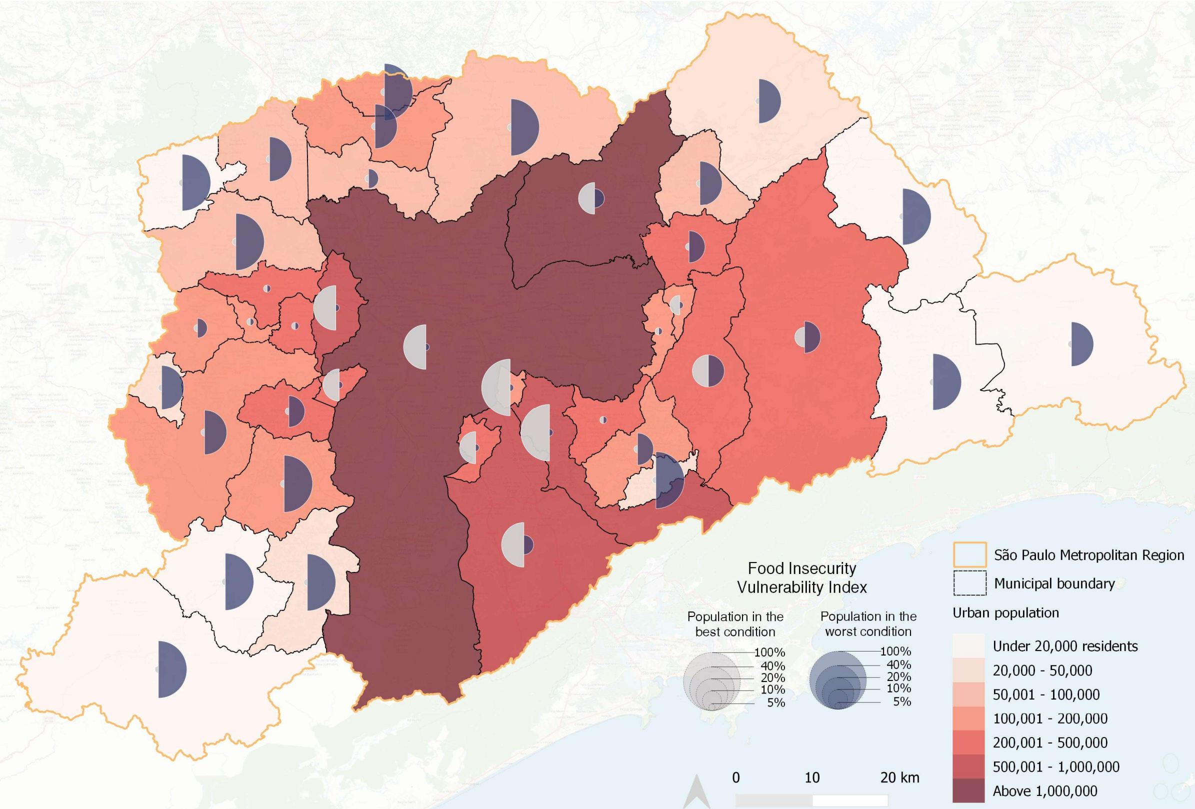

Figure 1. Proportion of the population in the worst conditions (low levels of FA and low levels of UI) versus the population in the best condition (high levels of Food Access and high levels of Urban Integration), distributed by municipalities, in 2010.

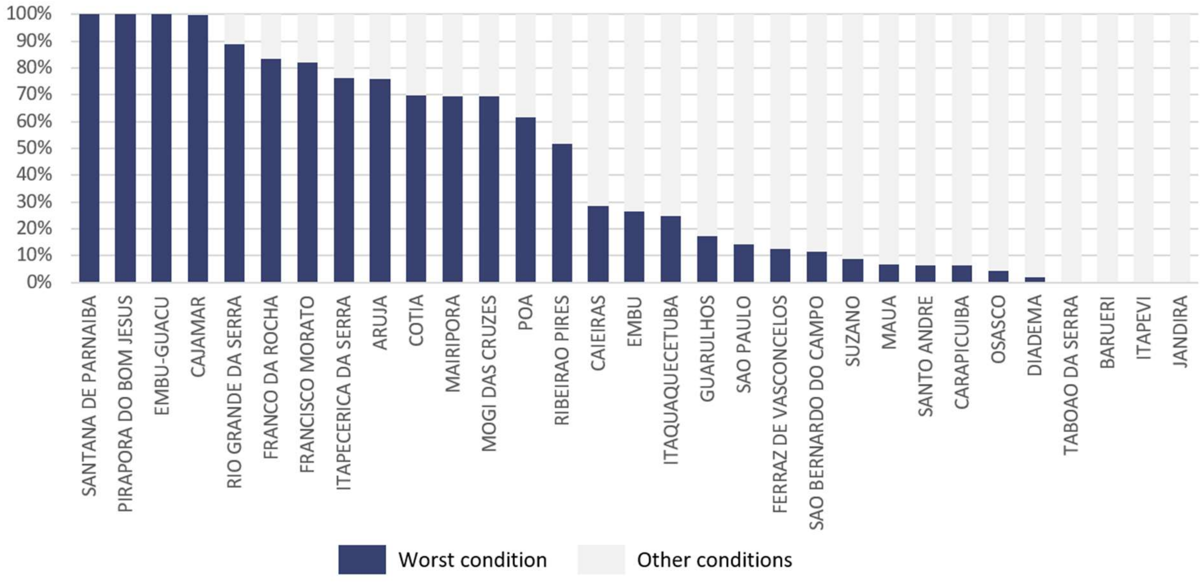

Figure 3. The population living in slums in the worst conditions (low level of Food Access and low level of Urban Integration), in relation to the total population in slums.

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