Research note

Intercensal Brazilian municipality stratification updating for health performance evaluation, 2015
doi: 10.5123/S1679-49742019000300004

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Abstract

Objective: to describe updating of stratification of the Brazilian municipalities in order to evaluate health performance.

Methods: this was a descriptive and methodological study with stratification of municipalities according to population size and conditions influencing health management, using data from the intercensal period (2015) and showing classification variations compared with the census period (2010); the original data on demographic characteristics, funding capacity and population purchasing power were adjusted for the year 2015 based on a baseline study conducted with census data. Results: some 15% of the municipalities were reclassified in the intercensal period, with the main factors of change being the conditions influencing health management. Conclusion: the need for intercensal updating of this form of classification was confirmed, given that the socioeconomic conditions of the municipalities vary in the five-year period; Primary Health performance evaluation should consider updated stratifications that include management conditions for the purpose of classification.

Keywords: Health Evaluation; Health Management; Health Planning; Methodology.

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Introduction

Grouping municipalities together according to their similarities is an important stage in public policy definition and evaluation. Population size is frequently used for stratifying Brazilian municipalities in Health-related studies.\textsuperscript{1-4} The population’s socioeconomic and health status as well as spatial conformation and structuring of health services also influence healthcare management conditions. Therefore, evaluating healthcare performance requires municipalities to be stratified in homogenous groups, taking into consideration not only population size but also the conditions mentioned above and their influence. With this concern in mind, a stratified model of Brazilian municipalities was developed based on data from the 2010 census period, taken here as a baseline study, in order to evaluate healthcare management performance.\textsuperscript{5}

Between 2010 and 2015, apart from having two national elections, Brazil underwent a series of denouncements of corruption and a process of economic recession began that affected its municipalities in a non-linear manner. The data used for the stratification referred to above may therefore have been subject to variations over that five-year period, as a result of these political, economic and social changes, thus influencing health management conditions in the municipalities. The assumption that such changes had taken place lead to population recounts and other population-based research being conducted in that time interval, given that estimates may not represent reality over the ten-year period between one census and another.\textsuperscript{6-10}

The objective of this study was to describe stratification of the Brazilian municipalities in order to evaluate health performance using data from the intercensal period (2015), presenting classification variations by comparison with the census period (2010).

Methods

This was a methodological descriptive study, with stratification of Brazilian municipalities according to population size and conditions influencing healthcare management, using secondary data available to the public. Stratification in the base-line study\textsuperscript{5} used data from 2010 according to the following stages:

(i) review of proposals for classifying municipalities and definition of indicator categories;\textsuperscript{11-13}

(ii) pre-selection of indicators, taking into consideration the consistency and stability of data on population size, conceptual validity in the literature, availability in a database and disaggregation to the municipal level; and identification of summary indicators (r>0.7 with the majority of the other indicators) and complementary indicators (r<0.7 with the summary indicators), using the correlation test;

(iii) factor analysis to identify indicators with more weight, comprised of three elements, ‘demographic characteristics’ (demographic density and urbanization rate), ‘funding capacity’ (per capita GDP) and ‘population’s purchasing power’ (health insurance coverage and percentage of extreme poverty); and indicator relativization, using a monotonic scale (0-1), where 1 corresponds to the largest value obtained and 0 corresponds to the smallest value obtained;

(iv) sum of the converted indicators;

(v) reduction of the element values to scores of 0, 1 and 2, based on quartile amplitude; and

(vi) sum of the scores of the three elements in order to define the condition that influences management, - unfavorable influence (up to 2 points);
- regular influence (3 to 4 points) or
- favorable influence (5 to 6 points); and
- association of influencing conditions with population size considered as a specific factor, dividing municipalities into small (less than 25,000 inhabitants), medium (25,000 to 100,000 inhab.) and large municipalities (more than 100,000 inhab.) (Figure 1).

For application of this in the intercensal period, we used the indicators found to have more weight in the factor analysis and updated them for the 2015 baseline year, this being a period coinciding with political variations bearing influence on the contexts of Brazilian municipalities;\textsuperscript{6} with adjustment of the origin of the data for some indicators. Demographic density...
used the population projections for the year 2015, whereas the 2010 data was kept for the urbanization rate because there was no updated intercensal data for it, nor was similar information adequate for the study’s objective identified. Per capita GDP and health insurance coverage were updated using 2015 data. The Brazilian Institute of Geography and Statistics (IBGE) does not have updated statistics on the percentage of extreme poverty for the year 2015, so we used the Single Social Program Registry (CadÚnico) extreme poverty percentage for 2015 instead, based on Bolsa Família Program data. This is a direct conditional income transfer program the data of which is constantly updated. It is assumed that the number of people registered with the Program represents people in situations of poverty and extreme poverty, by Brazilian municipality.

As such, our intercensal updating of municipality classification included 5,562 of the total of 5,570 Brazilian municipalities. We excluded five municipalities because they only came into existence in 2013, and could therefore not be compared with the classification obtained using 2010 data. A further three municipalities were excluded because they did not appear on the National Health Agency (ANS) database, and consequently there was no data on health insurance coverage for them.

It should be noted that during the stage in which the indicators were transformed into the monotonic scale, values considered to be outliers were converted into 1, the highest value on the scale, discarding discrepant values for relativization. Analysis was performed using electronic spreadsheets and Epi Info 7™.

### Results

The indicators proposed reveal great variability that demarcates the characteristics of each stratum. In 2015, variability is similar to that seen in 2010 (Table 1). In the intercensal period, the vast majority of the municipalities (75.0%) are small and few of them have favorable management (10.4%). The medium-sized municipalities (19.5%) are divided homogenously between the categories of influence on management. With regard to regional distribution, 63.7% of municipalities in the Northeast region are small and have unfavorable influencing conditions; 47% of the large municipalities
Table 1 – Mean values (standard deviation) found in the selected variables, by strata defined by population size and conditions influencing health management, Brazil, 2010 and 2015

<table>
<thead>
<tr>
<th>Stratum</th>
<th>Number of municipalities</th>
<th>Population (inhab.)</th>
<th>Demographic density (inhab./km²)</th>
<th>Urban households (%)</th>
<th>Per capita GDP² (per R$1,000)</th>
<th>Population in extreme poverty (%)</th>
<th>Population without health insurance (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Large</td>
<td>283</td>
<td>304</td>
<td>369,034</td>
<td>377,001</td>
<td>1,278.72</td>
<td>1,289.60</td>
<td>94.15</td>
</tr>
<tr>
<td>Medium favorable</td>
<td>364</td>
<td>370</td>
<td>50,335</td>
<td>50,464</td>
<td>160.52</td>
<td>164.97</td>
<td>91.18</td>
</tr>
<tr>
<td>Medium regular</td>
<td>341</td>
<td>378</td>
<td>46,239</td>
<td>46,193</td>
<td>96.06</td>
<td>101.66</td>
<td>75.26</td>
</tr>
<tr>
<td>Medium unfavorable</td>
<td>298</td>
<td>332</td>
<td>28,278</td>
<td>39,000</td>
<td>38.08</td>
<td>39.17</td>
<td>49.83</td>
</tr>
<tr>
<td>Small favorable</td>
<td>618</td>
<td>528</td>
<td>11,005</td>
<td>11,309</td>
<td>52.32</td>
<td>57.25</td>
<td>83.27</td>
</tr>
<tr>
<td>Small regular</td>
<td>1,911</td>
<td>1,832</td>
<td>8,471</td>
<td>8,574</td>
<td>28.05</td>
<td>28.28</td>
<td>65.50</td>
</tr>
<tr>
<td>Small unfavorable</td>
<td>1,750</td>
<td>1,810</td>
<td>10,191</td>
<td>10,237</td>
<td>29.57</td>
<td>30.81</td>
<td>44.70</td>
</tr>
</tbody>
</table>

a) GDP: gross domestic product.
b) Data not collected in intercensal period. 2010 data were replicated.

are located in the Southeast region; and the municipalities of the Midwest, Southeast, and Southern regions are concentrated in the small municipality stratum, with regular management conditions, having 61.2%, 40.6% and 47.0%, respectively (Table 2).

Comparison between census and intercensal data stratifications indicated changes in the classification of the municipalities. There were alterations due exclusively to changes in population size in 108 municipalities (1.9%); while in 21 municipalities (0.4%), there were changes both in size and in conditions influencing management. Conditions influencing management, with no change in population size, were responsible for the alteration of the classification of 713 municipalities (12.8%). In all, 842 Brazilian municipalities (15.1%) were reclassified in the analysis period, with regional variations, in particular in the Northern region (20.5%) (Table 3).

Discussion

Organizing the Brazilian municipalities into homogenous groups is an important tool for developing studies on health management performance. The results of the stratifications demonstrated that population size alone is insufficient for achieving this classification, in view of the conditions that influence management in each population size stratum. Demographic, funding and economic aspects are important for characterizing municipalities\(^6\)\(^–\)\(^22\) and, along with population size, undergo changes over the years.\(^6\)\(^–\)\(^24\)

The majority of the Brazilian municipalities are small and classified as having conditions that influence management so that it is regular or unfavorable, with a tendency of (i) lower technical and administrative capacity to ensure adequate management\(^23\)\(^–\)\(^25\) and (ii) a high percentage of inefficiency with regard to health actions and results.\(^26\) These facts reinforce the need to work through regional healthcare networks as an alternative for economy of scale and qualified health actions, ensuring better access and quality in the delivery of these services to the population.\(^21\)

Comparison between the classification of intercensal data (current) and census data (baseline study) shows more than 15% of municipalities moving between strata, with management conditions being the main change factors. The variables used summarize municipal management conditions and were proposed based on...
the baseline study through factor analysis of 28 variables analyzed in the literature as being important for health management. The urbanization rate and demographic density differentiate more urbanized municipalities from those with a more dispersed population where resource allocation and access is more difficult; per capita GDP indicates differences in the municipality’s own capacity to invest in health; and the population’s dependence on public health services can be measured by private health insurance coverage and by the percentage of the population in extreme poverty.

Change in population size was exclusively responsible for reclassification of just 108 (1.9%) of the municipalities. According to this study, if 842 (15.5%) changed their stratum, it can be concluded that the characteristics associated with management conditions also changed during the five-year interval and caused most of the strata changes.

In the period 2010-2015, GDP increased in Brazil, with a slight increase in expenditure on public health services and actions. Municipalities having a greater increase in GDP and per capita income tend to have more resources for social programs involving income transfer, thus generating greater reduction in income inequality and poverty. Furthermore, considerable progress has been seen since the Bolsa Família Program was implemented in terms of reduction in the numbers of people living in extreme poverty. This underlines the mobility of GDP as an indicator and the need for frequent reconsideration.

It should be noted that in the demographic characteristics, 2010 data were repeated for the urbanization rate, which is one of the indicators relating to management conditions. There is no intercensal collection of this information. Other data on urbanization we identified is calculated by the

Table 2 – Number and percentage of municipalities in each stratum (defined by population size and conditions influencing health management) of intercensal classification, by region of the country, Brazil, 2015

<table>
<thead>
<tr>
<th>Region</th>
<th>Intercensal classification</th>
<th>Large</th>
<th>Medium favorable</th>
<th>Medium regular</th>
<th>Medium unfavorable</th>
<th>Small favorable</th>
<th>Small regular</th>
<th>Small unfavorable</th>
<th>n</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>North</td>
<td></td>
<td>26</td>
<td>5.8</td>
<td>4</td>
<td>0.9</td>
<td>47</td>
<td>10.5</td>
<td>78</td>
<td>17.4</td>
<td>4</td>
</tr>
<tr>
<td>Northeast</td>
<td></td>
<td>62</td>
<td>3.5</td>
<td>10</td>
<td>0.6</td>
<td>168</td>
<td>9.4</td>
<td>232</td>
<td>13.2</td>
<td>3</td>
</tr>
<tr>
<td>Midwest</td>
<td></td>
<td>21</td>
<td>4.5</td>
<td>37</td>
<td>8.0</td>
<td>28</td>
<td>6</td>
<td>1</td>
<td>0.2</td>
<td>49</td>
</tr>
<tr>
<td>Southeast</td>
<td></td>
<td>143</td>
<td>8.6</td>
<td>212</td>
<td>12.7</td>
<td>92</td>
<td>5.5</td>
<td>11</td>
<td>0.7</td>
<td>297</td>
</tr>
<tr>
<td>South</td>
<td></td>
<td>52</td>
<td>4.4</td>
<td>127</td>
<td>10.7</td>
<td>31</td>
<td>2.6</td>
<td>2</td>
<td>0.2</td>
<td>227</td>
</tr>
<tr>
<td>Brazil</td>
<td></td>
<td>304</td>
<td>5.5</td>
<td>390</td>
<td>7.0</td>
<td>366</td>
<td>6.6</td>
<td>324</td>
<td>5.9</td>
<td>580</td>
</tr>
</tbody>
</table>

Table 3 – Changes identified in classification by strata (by population size and conditions influencing health management) using census and intercensal data, by region of the country, Brazil, 2015

<table>
<thead>
<tr>
<th>Region</th>
<th>Population size and management conditions</th>
<th>Same population size</th>
<th>Different management conditions</th>
<th>Population size changed</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Same management conditions</td>
<td>Different management conditions</td>
<td>Same management conditions</td>
<td>Different management conditions</td>
</tr>
<tr>
<td>North</td>
<td></td>
<td>356</td>
<td>79.5</td>
<td>20</td>
<td>4.5</td>
</tr>
<tr>
<td>Northeast</td>
<td></td>
<td>1,553</td>
<td>86.7</td>
<td>41</td>
<td>2.3</td>
</tr>
<tr>
<td>Midwest</td>
<td></td>
<td>400</td>
<td>85.8</td>
<td>5</td>
<td>1.1</td>
</tr>
<tr>
<td>Southeast</td>
<td></td>
<td>1,415</td>
<td>84.8</td>
<td>27</td>
<td>1.6</td>
</tr>
<tr>
<td>South</td>
<td></td>
<td>996</td>
<td>83.8</td>
<td>15</td>
<td>1.3</td>
</tr>
<tr>
<td>Brazil</td>
<td></td>
<td>4,720</td>
<td>84.9</td>
<td>108</td>
<td>1.9</td>
</tr>
</tbody>
</table>
Brazilian Agricultural Research Company (EMBRAPA) but relates to household spatial concentration and does not identify whether households are located in the urban or rural area. If it had been possible to use more up-to-date urbanization rates, we might have identified more municipalities changing from one stratum to another.

After five years, great indicator variability was still found between the strata. Reapplying the model proposed confirms its internal validity and coherence in relation to the theoretical reference used by the baseline study. The aim of updating stratification is to provide researchers with information for evaluating the healthcare performance of municipalities with similar conditions of territory, level of economic development and regional role. Stratification seeks to increase the alternatives frequently used by researchers and services, based solely on population size or who use, separately, another factor such as the municipal human development index (HDI-M) or Family Health Strategy coverage. Based on the analysis presented, these options appear to be insufficient for indentifying homogenous strata of municipalities.

Authors’ contributions

Willemann MCA and Medeiros JM contributed with data acquisition and analysis and drafting the preliminary versions of the manuscript. Lacerda JT and Calvo MCM contributed by conceiving the study, interpreting the data and critically revising the manuscript. All the authors have approved the final version and are responsible for all its aspects, including its precision and integrity.

References


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