

# A beacon for the COVID-19 epidemic control in Brasil: seroepidemiological population-based surveys

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The novel severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), which was firstly identified in late December 2019 in China, has spread rapidly worldwide. However, epidemics are expressed from different forms around the world. The epidemic curves do not follow a “natural path” due to different social, epidemiological, and cultural contexts, access to health services and to diagnostic tests, vaccine, and preventive measures in different regions<sup>1</sup>. Oliveira et al.<sup>2</sup> investigated disparities in the clinical profile of coronavirus disease (COVID-19) and in the groups that can be more affected by the disease in Brasil, China and Italy since the pandemic beginning. In Brasil, the authors reported the highest percentage of cases among individuals aged <60, male, and diabetes-affected ones<sup>2</sup>.

Despite efforts put to maintain social distancing, the lack of effective drugs and of a vaccine for COVID-19 have led to an increase in the disease incidence in various parts of Brasil<sup>3</sup>. However, there is limited information available on the epidemic and its indicators in the country due to the scarcity of diagnostic tests and to the large proportion of mild and asymptomatic cases. In addition, there is a lack of parameters and information concerning the disease transmission in different regional contexts. Most studies conducted in the first few months of the COVID-19 pandemic were focused on symptomatic patients with severe manifestations of the disease or in its acute stages. Also, they were obtained in one-off testing, in convenience tests in high-risk populations, or in health professionals<sup>4-6</sup>.

Population-based epidemiological surveys are an interesting strategy to address the lack of indicators for the COVID-19 epidemic and may answer relevant questions to better understand its dynamics<sup>7</sup>. They provide information regarding the extent of viral circulation and dissemination of the disease (R effective), thereby allowing more robust estimates of lethality rates and providing parameters for prediction models in different transmission scenarios<sup>8</sup>. Estimates of the actual prevalence of

infection in the population are useful for assessing the impact of public health interventions and can be used in clinical vaccine trials.

Population-based surveys have guided public health measures in several countries. Cross-sectional studies in Spain have shown the most affected regions around Madrid and the disease transmission<sup>9</sup>. Furthermore, various authors in Iceland have identified populations at risk<sup>10</sup>. A study conducted in Gangelt, Heinsberg district, in Germany, where the first case of COVID-19 was announced in the country, reported that 15% of the city population presented antibodies against SARS-CoV-2. The first surveys carried out in the United States, in Santa Clara and in Los Angeles, California, anticipated the concern of viral spread<sup>11,12</sup>.

Surveys have also been conducted in Brasil, some of which were restricted ones, and others had a greater scope<sup>13-18</sup>. Among the population-based investigations for COVID-19 undertaken globally that had a greater coverage, the seroepidemiological survey performed every two to three weeks in Brasil stands out, which was organized by Universidade Federal de Pelotas<sup>15</sup>. Random population samples in 133 cities that are commercial and economic hubs in 27 states from five regions of Brasil were investigated and underwent immunochromatographic testing for the detection of IgM/IgG antibodies, using the lateral flow assay. In May of 2020, the results revealed a great variability in the prevalence of antibodies against SARS-CoV-2 in the country, from >1% in cities in the South and Southeast region to 20–25% in the North. Additionally, a high prevalence rate (>10%) was reported in cities on the Amazon River banks in the first two survey stages. This extensive field effort led to around 30.000 collections at each survey stage. The first results showed a high rate of transmission growth (53% every three weeks) and revealed that there were around seven unknown cases for every reported case. Another intriguing

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result under investigation suggests that the indigenous people in the country has greater susceptibility (3.7%) than the white population (0.6%) of the Northern region. A mosaic of epidemics with different speeds and impacts needs to be analyzed in various ways, requiring specific actions from control and surveillance agencies.

Other basic surveys in Brasil have disseminated markers of epidemics at the local level, with strategic information to adjust control measures. In Ribeirão Preto, São Paulo State, the seroprevalence was 1.2% in the first week of May of 2020, revealing low viral circulation<sup>14</sup>. In Campinas, also in the State of São Paulo, it was 2.2% based on the results of the first testing conducted in June of 2020. This prevalence, then, increased to 3.7% in July of 2020, with a higher rate among the poor population of Campinas, as disclosed by the Municipal Health Department (MHS, acronym in Portuguese)<sup>19</sup>. In a study focused on the prevalence of antibodies in a population sample from six districts in the city of São Paulo, in which three districts were the most affected, among individuals aged >18, the rate was 5.4%, thus revealing that the actual number of individuals infected was 10 times greater than that notified by the epidemiological surveillance from May of 2020<sup>16</sup>. Several stages of the survey in São Paulo in 2020, released by the MHS, revealed the seroprevalence to be 11.1%, in June, reaching 15.6% in December, with increased positivity in the elderly and poor individuals, indicating social inequality.

Results of school surveys performed from August of 2020 that were reported in the media led to the modification of the MHS guidelines, which postponed the opening of face-to-face classes in São Paulo. In April, in the state of Rio Grande do Sul, serial surveys in nine sentinel cities revealed that the epidemic was in the early stage, although it was on the rise<sup>13</sup>. In the

Espírito Santo state in the last week of May of 2020, serological survey in 19 towns identified that 5.1% of the Capixaba population had antibodies against SARS-CoV-2; 70% of the population included black and brown individuals. Serial serological surveys in representative samples of the population of Teresina, in Piauí State, showed transmission growth from April to May<sup>17</sup>. In Maranhão State, Silva et al. showed prevalence rates of around 40% between July and August of 2020<sup>18</sup>.

These results highlight the importance of learning about the parameters of epidemics on population bases, particularly in serial stages that reveal transmission trends, the groups mostly affected by the epidemic and those with small exposure to the disease, helping to guide the control measures. Thus, this strategy in cities or micro regions can be supported by State Health Departments and the Brazilian Department of Health for the systematic monitoring of the epidemic and its phases. It can also guide interventions at the local or regional levels, thus supporting decisions concerning the relaxation of social distancing and identifying individuals that could return to work or school.

Some limitations of these initiatives are the variable accuracy and heterogeneity of the available serological tests<sup>20</sup>. It is worth highlighting the controversies regarding the performance and duration of these antibodies during the immune response, considering that the serological tests do not identify neutralizing antibodies against SARS-CoV-2, generating debates regarding the duration of immune response and other factors that modulate herd immunity<sup>7</sup>.

In conclusion, there are many questions regarding the epidemic that need to be clarified. However, population-based surveys indirectly monitor the viral circulation in the community and act as a beacon for public health, shedding light on disease transmission in specific regions, helping to adjust measures accordingly.

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