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The complexity of non-pharmaceutical interventions in Brazilian municipalities

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Brazil has one of the fastest-growing COVID-19 epidemics in the world. As of 6 September 2020, Brazil recorded 4,123,000 cases and 126,203 deaths. SARS-CoV-2 was introduced at least 100 times in Brazil.[1] Non-pharmaceutical interventions (NPIs), although insufficient, reduced virus transmission.[1,2] Changes to the national COVID-19 notification system and uncoordinated public health measures nationwide may have contributed to the continuous spread of the ongoing epidemic.[3] Here, we discuss the complexity of the adoption of NPIs in Brazilian municipalities.

Our data were gathered in a municipal-level survey conducted by the Brazilian Confederation of Municipalities (*Confederação Nacional de Municípios* – CNM). This is the largest city-level study in the country of the COVID-19 epidemic to date. Although national and state-level NPI strategies have been examined,[4] municipal analysis in Brazil is still sorely missing, especially given the scope of that administration level, which includes 5,568 municipalities and the Federal District.

The CNM interviewed 4,027 (72.3%) of 5,568 mayors and the Federal District's government between 13 May and 30 July 2020. Mayors were contacted through CNM's call centre and they could answer to the survey on the phone or receive a protected password to respond online at a later time. When mayors did not know the answer, they could suggest an alternative respondent, such as the municipal health secretary. Response rate varied by region: North (29.1% of 450 municipalities), Northeast (50.5% of 1,793 municipalities), Centre-West (71.7% of 466 municipalities), Southeast (90.2% of 1,668 municipalities) and South (96.6% of 1,191 municipalities). This difference relates to municipal infrastructure and to the fact the survey started from the South and moved upwards in the country. The survey assessed the implementation and relaxation of NPIs in each municipality.

A number of municipalities closed non-essential services, prohibited large gatherings, reduced public transportation, and implemented cordon sanitaires, in early March, with a rapid uptake in mid-March (Figure 1A). At that time, COVID-19 cases were restricted to a few highly populated state capitals, with cases mostly associated with overseas travel.[5] Of 3,958 mayors that responded to the question on implementing social isolation (closure of all non-essential services), 2,738 (69.2%) implemented the measure before the first reported case in their municipality (Figure 1B). This raises the question of how SARS-CoV-2 spread from 296 municipalities (7.5%), on 31 March 2020, to 4,196 municipalities (75%), as of 31 May 2020 (Figure 1A). Our data suggest that a lack of national coordination in relaxing distancing measures may have played an important role.

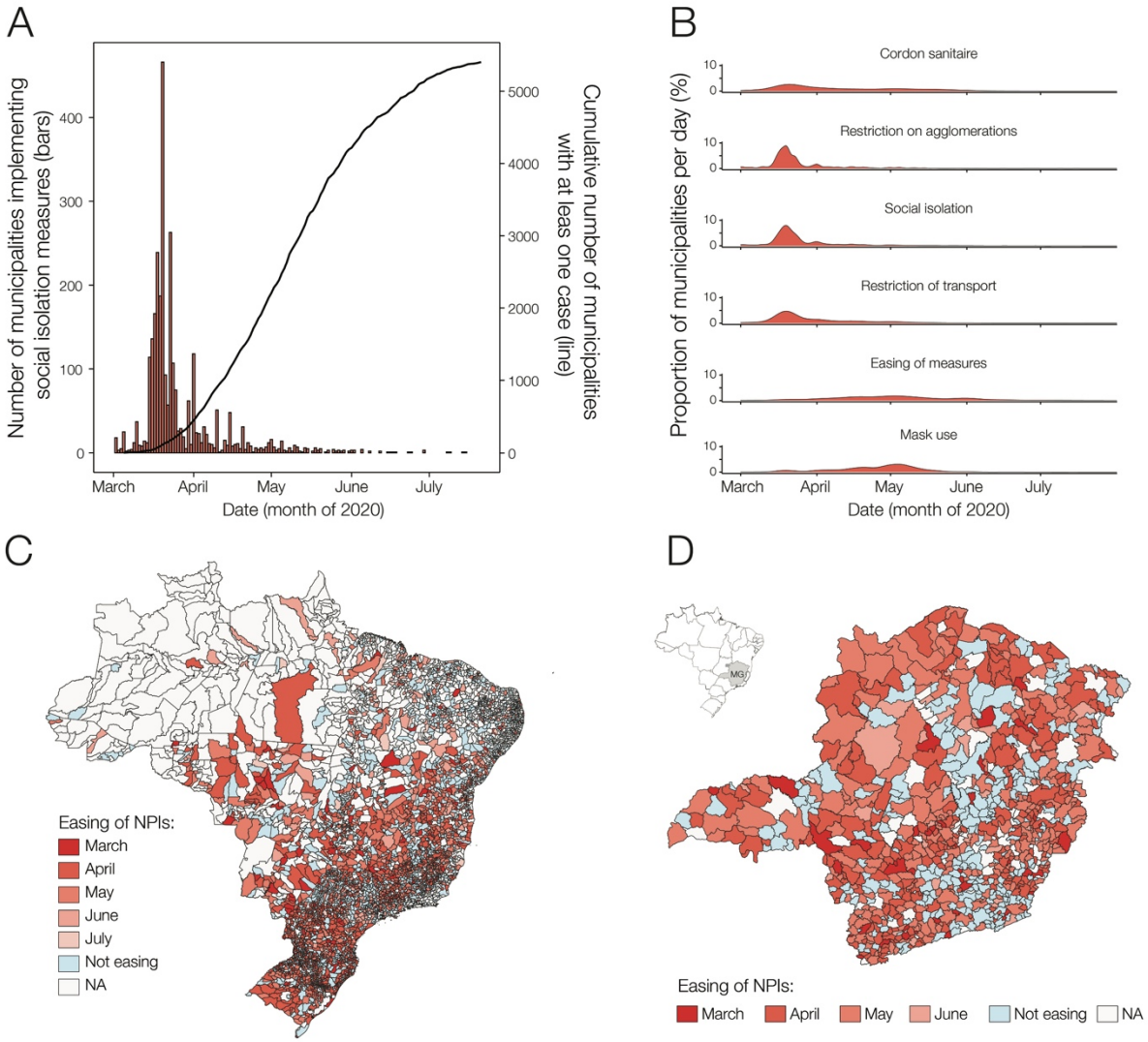

Figure 1. A) Prohibition of non-essential services in the country and the cumulative number of municipalities reporting at least one case. B) Adoption and easing of NPIs in the country. C) Easing of NPIs in Brazil. D) Easing of NPIs in the state of Minas Gerais (MG). NA, not appliable.

The Brazilian Supreme Court ruled on 15 April 2020 that mayors and governors were autonomous in their decisions related to the pandemic. This was motivated by concerns that the

president could aggravate the crisis by vetoing physical distancing decisions.[6] Governors and mayors led the implementation of distancing measures and progressively governors empowered mayors to manage the pandemic locally. Before lifting NPIs, municipalities' capacity to respond to the pandemic (number of physicians and ICU beds per capita) would be assessed, alongside an absence of confirmed cases (e.g. Decree 47025, passed on 07 April 2020 in Rio de Janeiro State). However, we found no association between easing NPIs with the absence of confirmed COVID-19 cases in the evaluated municipalities (spearman's rho = -0.077, p = 0.0003). In addition, among 505 municipalities with a peak of at least 20 daily cases that also reported relaxing NPIs, 452 (89.5%) did so before reaching their local peak.

NPIs have been associated with fewer and delayed cases in other countries;[7] however, lack of coordination has been associated with disease spread and resurgence.[8] Although distancing measures were adopted across Brazil in the early stages of the pandemic, easing of these measures began as early as the end of March (Figure 1C), often disregarding decisions by neighbouring municipalities, as illustrated in Figure 1D for the state of Minas Gerais. We chose Minas Gerais because of the high response rate (100% of mayors interviewed, though 12.8% answered partially), and because almost one sixth of all Brazilian municipalities are located in that state. Municipal borders do not limit the flow of individuals, who may shop or work across towns.[9] Nevertheless, as figure 1C-D shows, decisions to easy NPIs were not coordinated between bordering cities.

The increase in the number of reported cases results from multiple factors, including non-compliance, delayed implementation of social distancing measures, superspread through mass gathering events and the lack of coordinated control measures with neighbouring municipalities. Currently, Brazil faces a lack of national coordination in the enforcement of COVID-19 control

measures. Early and cohesive closure of non-essential activities was short-lived, and municipalities are now lifting distancing measures asynchronously, starting as early as late March. The easing of NPIs was not always related to reductions in confirmed cases, nor coordinated between neighbouring towns. City borders are porous and cities that have maintained strict social distancing policies may face a growing number of cases because of external decisions. This observation is important as a policy evaluation of Brazil's management of the pandemic will need to account for the uneven duration of social distancing in the country.

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