"Flattening the curve": effective measures from Niterói city (Rio de Janeiro, Brazil) for COVID-19 control

"Achatando a curva": medidas eficazes da cidade de Niterói (RJ, Brasil) para o controle da COVID-19

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Abstract

Background: In Brazil, some local city government's adopted several measures, which probably had a positive impact on COVID-19 control. **Objective:** To report the distribution of COVID-19 cases in Brazil, Rio de Janeiro state and Niterói city. In parallel, we aimed to demonstrate the preventive strategies adopted by Niterói city. **Method:** Data provided by the Brazilian Ministry of Health and Municipal Health Foundation of Niterói were used to report COVID-19 cases and deaths. For some analysis, data were grouped by week and normalized for 100,000 inhabitants. **Results:** By July 18th, 2020, Brazil reported 2,074,860 cases and 78,772 deaths and Rio de Janeiro state registered 135,230 cases and 11,919 deaths; both still presenting ascendant curves for COVID-19 deaths. In contrast, the rate of new deaths per 100,000 inhabitants is consistently lower in Niterói city. Importantly, we estimated that 712 deaths were prevented by the measures adopted by Niterói city, in comparison to which was observed in Rio de Janeiro. **Conclusion**: The early preventive measures adopted in Niterói city were effective in reducing both the viral spread and rate of deaths. In this regard, this discussion could be relevant for making future decisions during the COVID-19 outbreak in Brazil.

Keywords: coronavirus disease 2019; preventive measures; Niterói city; Brazil.

Resumo

Introdução: No Brasil, algumas cidades adotaram várias medidas que provavelmente tiveram um impacto positivo no controle da Covid-19. **Objetivo:** Relatar a distribuição dos casos de Covid-19 no Brasil, no estado do Rio de Janeiro e na cidade de Niterói. Paralelamente, buscamos demonstrar as estratégias preventivas adotadas pela cidade de Niterói para o controle da Covid-19. **Método:** Dados fornecidos pelo Ministério da Saúde e Fundação Municipal de Saúde de Niterói foram usados para relatar o número de casos e óbitos causados pela Covid-19. Para algumas análises, os dados foram agrupados por semana e normalizados para 100.000 habitantes. **Resultados:** Até 18 de julho de 2020, o Brasil registrou 2.074.860 casos e 78.772 mortes e o estado do Rio de Janeiro registrou 135.230 casos e 11.919 mortes; ambos ainda apresentando curvas ascendentes para mortes por Covid-19. Em contrapartida, a taxa de novos óbitos/100.000 habitantes é consistentemente menor na cidade de Niterói. Estimamos que 712 mortes foram evitadas pelas medidas adotadas pela cidade de Niterói, em comparação com o que foi observado no Rio de Janeiro. **Conclusão:** As medidas preventivas adotadas pela cidade de Niterói foram eficazes na redução tanto da disseminação do vírus quanto da taxa de óbitos. Portanto, esta discussão se mostra relevante para a tomada de decisões futuras durante o surto de Covid-19 no Brasil.

Palavras-chave: *coronavirus disease* 2019; medidas preventivas; cidade de Niterói; Brasil.

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INTRODUCTION

In December 2019, a substantial increase in pneumonia cases with an unknown cause was observed in Wuhan, China. Belonging to the *Coronaviridae* family, the SARS-CoV-2, firstly known as 2019-nCoV, was identified as responsible for this new disease, which was further called COVID-19 (coronavirus disease 2019)[1,2]. Subsequently, after the dramatic increase in the number of cases in China, the virus promptly spread to other countries and, by February 27th, 2020, 46 countries (including Brazil) had already been affected[2,3]. Therefore, the World Health Organization (WHO) declared COVID-19 as a pandemic[4] on March 11th.

Brazil was the first country in Latin America to register cases of SARS-CoV-2 infection[5] and is currently one of the main epicenters of the COVID-19 pandemic. Therefore, as a means to provide a Brazilian perspective in the current scenario, we aimed to describe SARS-CoV-2 entry in Brazil, reporting the profile of COVID-19 cases and deaths in the state of Rio de Janeiro, particularly in Niterói city, a municipality from Rio de Janeiro state. In this regard, we discuss key points concerning preventive strategies adopted by the local government's authorities, which probably had a positive impact on COVID-19 control, as we will show hereafter in more detail.

METHODS

The Brazilian Ministry of Health platform, Coronavirus Panel, was used to describe the number of confirmed cases and deaths at the national level[6]. This platform provided daily epidemiological data (number of confirmed cases and reported deaths) also by the state until June 8th. After June 9th, this platform suffered some modifications. Even though the aim of this was to provide broader data (i.e. information related to diagnostic tests for other respiratory viruses performed in the public health network), the daily number of cases and deaths were not available anymore. Therefore, up to this date, daily numbers are reported by a consortium formed by the main media vehicles in Brazil, which assembles data provided by the Health Secretariats of different cities and states throughout the country.

Data from the city of Niterói was obtained from the website of the Municipality of Niterói, which also included the description of preventive measures adopted by the city[7]. To expand the scope of our analysis, we analyzed all epidemiological surveillance bulletins available by the Municipal Health Foundation of Niterói (COVIG – Coordenação de Vigilância em Saúde), which are daily officially published on Twitter.

Lastly, we estimated the number of deaths that were avoided in the city of Niterói as a probable consequence of the preventive measures adopted by the city's authorities. Shortly, for practical purposes, we estimated the weekly average of deaths per 100,000 inhabitants (the average number of daily deaths in the last 7 days per 100,000 inhabitants). For this, we considered the 2019 census for the total population of Brazil – 210,147,125 inhabitants, Rio de Janeiro State – 1,726,4943 inhabitants and Niterói city – 513,584 inhabitants[8]. Thus, for each of the weeks that followed consecutively, firstly these differences were calculated, secondly multiplied by seven, and finally, they were totaled at the end of the total period. The calculation was performed using the number of deaths in the numerators and the respective total populations in the denominators. The method conceptually represents what is done similarly for the calculation of differences in areas under the curves, but in this case, the total difference in the number of deaths, assuming them as spared lives.

RESULTS AND DISCUSSION

Until the moment of data compilation (July 18th, 2020), Brazil registered 2,074,860 cases and 78,772 confirmed deaths, still presenting an upward curve of new cases and deaths caused by COVID-19, despite the adopted measures to contain the pandemic. Rio de Janeiro has been the second most affected state since the beginning of the epidemics, accounting for 135,230 cases and 11,919 deaths, which represents 6.5% of total cases and 15.1% of total deaths in Brazil[6] (Figure 1A). In Figure 1B, we demonstrate the distribution of cases and deaths in Niterói city and Rio de Janeiro state. Since the first case was confirmed in Niterói, we

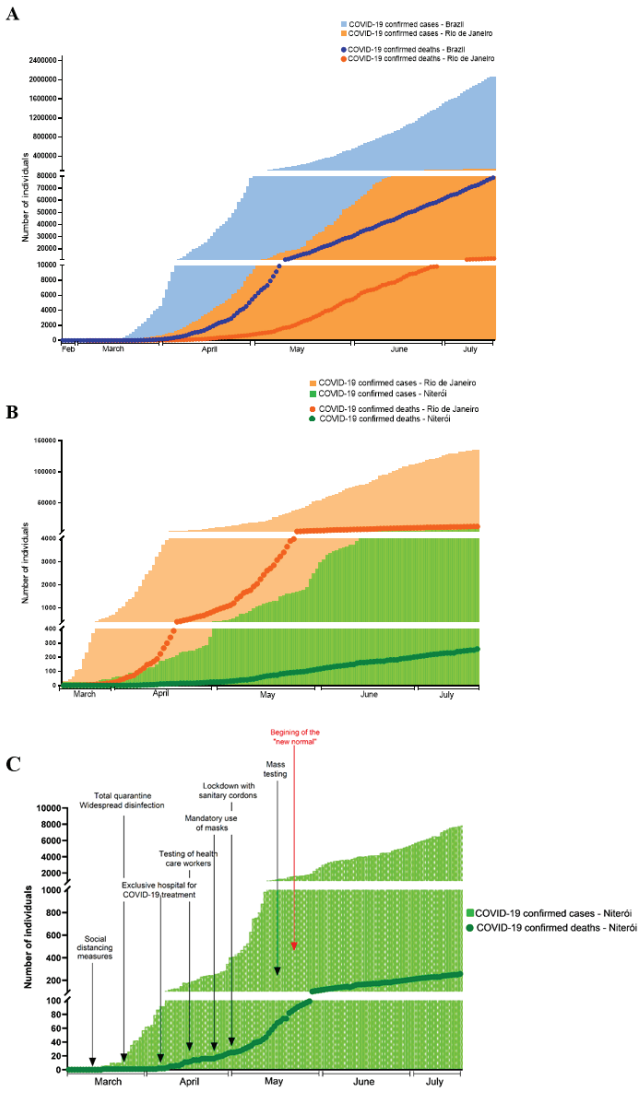

Figure 1. COVID-19 in Brazil, Rio de Janeiro State and Niterói city (year 2020). Daily distribution of confirmed cases and deaths caused by SARS-CoV-2 infection in Brazil (**A**), Rio de Janeiro State and Niterói city (**B**). (**C**) Timeline representation of some preventive measures for COVID-19 control adopted by the local government of Niterói in association with the daily distribution of confirmed cases and deaths. Source: Coronavirus Panel (Brazilian Ministry of Health) and Municipal Health Foundation of Niterói (COVIG)

observed that the growth curve of cases showed an upward trend at two different moments, by the end of March and by the end of April. We also noticed that the rate of deaths caused by COVID-19 is consistently lower in Niterói in comparison to Rio de Janeiro (3.3% *vs.* 8.8% of total cases, respectively, on July 18th)[6]. Of note, the first confirmed COVID-19 case in Rio de Janeiro city was confirmed in March, three days before the first case in Niterói and, a month later, the study by Cavalcante & Abreu (2020) reported a lethality rate of around 5%[9]. However, in a recent nationwide study with around 100,000 patients from all over Brazil, the mortality rate from the state of Rio de Janeiro is still superior to other states[10].

Trying to contextualize this initial impression, we emphasize that even before the first case was confirmed, the local government of Niterói has been articulating several strategies aiming at COVID-19 restraint. Some of the measures adopted by the city are presented in Figure 1C in association with the daily distribution of confirmed cases and deaths caused by

SARS-CoV-2 infection. Importantly, on May 21st, Niterói announced the partial re-opening of local commerce and public transport, representing the beginning of the "new normal". By the first weeks of June, we can notice a significant decrease in the number of new cases and a stable curve in the reported number of deaths.

Our next step was to analyze the proportion of new cases and new deaths caused by COVID-19 which were recorded by the State of Rio de Janeiro and Niterói city progressively week by week, after adjusting the rate for 100,000 inhabitants (Figure 2). We observed that Niterói city presented a higher rate of new cases/week/100,000 inhabitants when compared to Rio de Janeiro State. On the other hand, the rate of new deaths/week/100,000 inhabitants is significantly lower in Niterói. We estimate that 712 deaths were prevented when comparing the patterns observed in Niterói and Rio de Janeiro.

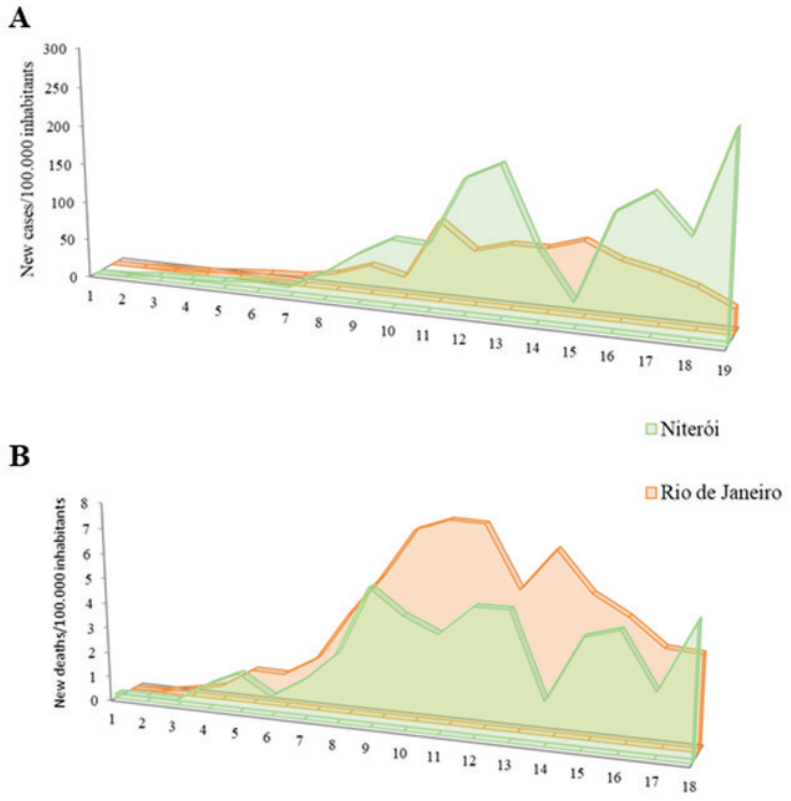

Figure 2. Weekly distribution of new cases (**A**) and deaths (**B**) per 100,000 inhabitants caused by SARS-CoV-2 infection in Rio de Janeiro state and Niterói city (year 2020). Source: Coronavirus Panel (Brazilian Ministry of Health) and Municipal Health Foundation of Niterói (COVIG)

Despite that in Brazil the Public Health System (SUS) still faces a significant challenge with COVID-19 epidemics, the city of Niterói became an example in preparing different strategies to contain SARS-CoV-2 dissemination, being recognized by national and international media[11,12]. In the same month that China announced the blockade in Wuhan, Niterói created a rapid response group to plan early public policies to deal with the pandemic. Of note, this planning started when the disease had not yet arrived in Brazil. Subsequently, social isolation was strongly recommended for the population and several preventive measures were adopted a few days later after the first case was confirmed, such as rearrangement of hospital services

(e.g. suspension of elective surgeries, increased working hours and hiring more healthcare professionals), widespread disinfection of the city, suspension of classes in schools and universities and distribution of 1,000,000 masks. By April 22nd, Niterói implemented 43 different measures for COVID-19 control.

As mentioned above, one may notice that the first wave of confirmed cases in the city of Niterói came at the beginning of April, with the start of testing healthcare professionals working in the frontline against the disease. As observed in other countries, healthcare workers constitute a very significant parcel of COVID-19 cases[13]. Recently, it was reported that in Pernambuco (a state in northeast Brazil), health workers constituted 30.8% of total COVID-19 cases in the state[14]. In addition, the city's Health Secretariat rapidly expanded the number of tests performed in the city. By the end of June, Niterói has performed around 30,000 tests for COVID-19 and a few months later, by October 2020, this rapidly increased to 100,000 tests, accounting for around 20% of the population[7]. Importantly, it was not possible to compare with data concerning a total number of tests performed in Rio de Janeiro city, since these numbers were underreported by the city's authorities until the moment of data compilation for this study. Taken together, these measures probably reflect the high number of confirmed cases per 100,000 inhabitants reported by the city of Niterói, which most likely reduces the unpredictable rate of underreporting, a relevant problem still present in Brazil[15].

From the end of April to the beginning of May, Niterói adopted more imposing measures such as mandatory use of masks, total lockdown of the city with sanitary cordons and mass testing. It was reported by the city's authorities that by the end of March, isolation rates reached up to 70% of the population. This decreased to 56% at the beginning of May and 47.7% by the end of June. This fact shows that even with gradual re-opening, Niterói's inhabitants were able to sustain the social distancing measures[7]. The significant traffic restrictions with neighboring municipalities and mandatory use of masks for all population may lead to a new plateau in the number of notified COVID-19 cases and deaths that we observe at that point, with a subsequent reduction in the number of cases per 100,000 inhabitants by the beginning of June. Nevertheless, the city of Rio de Janeiro reported similar rates of social distancing[16], thus the lower mortality in Niterói could also be explained by the other anticipated preventive measures, which probably contributed to the city's preparation to deal with severe cases, such as the inauguration of Brazil's first exclusive hospital for COVID-19 treatment, with 140 beds including specialized intensive care units. Importantly, anticipated preventive measures observed in different states and cities throughout Brazil have also a positive impact in reducing COVID-19 spread and mortality rates[14,17-19].

Niterói has already demonstrated effective epidemiological control initiatives in previous epidemics, such as the ones caused by arboviruses (Dengue, Zika and Chikungunya), which are very relevant in Brazil[7]. In the current epidemics, we presented here several strategies early implemented by Niterói which lead to a positive response. Not only in primary care, but also contributing to the scientific knowledge highly requested in the current literature, Niterói has started epidemiological surveillance in partnership with Fundação Oswaldo Cruz and Águas de Niterói (a scientific institution for research in Health Science and city's water company, respectively) to monitor SARS-CoV-2 dissemination in the municipal sewage network. An interesting study was designed, and the group observed that SARS-CoV-2 was detected in 41.6% of samples obtained from the city's sewage system[20]. Recently, a partnership with the Universidade Federal Fluminense was also announced by the city of Niterói, in order to increase the test capacity in the city[7]. This also highlights the importance of public universities and research centers working with local authorities for COVID-19 control, even with the constant reduction of financial support from the government[19,21].

Currently, several states and cities in Brazil began a plan of transition to the "new normal", in terms of changes in human behavior during and after this pandemic, including limiting person-to-person contact, such as handshaking and hugging. Also, this accompanies the gradual opening of local commerce and new rules of collective hygiene and physical space occupation to minimize SARS-CoV-2 transmission.

In this brief report, we presented some strategies implemented by the city of Niterói which lead to an early diagnosis of COVID-19 and slower progress of SARS-CoV-2 dissemination during this initial stage of the pandemic, reflecting lower mortality rates. Thus, Niterói became a positive example of COVID-19 epidemic control and patient care. This highlights the role of local authorities in strategically anticipating SARS-CoV-2 spread in Brazilian cities, which science-based actions had a major impact on COVID-19 control.

CONCLUSION

In summary, we believe that the association between strict social restrictive measures and the expansion of population testing are the best strategies for COVID-19 control, as already seen in other countries and following the approaches adopted by the city of Niterói. As the phenomenon of "flattening the curve" takes place, we should return to routine activities with extreme caution, adapting ourselves to the "new normal".

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