**ORIGINAL ARTICLE**

Estimando o impacto da COVID-19 na cobertura vacinal de indígenas no Brasil ​

Estimating the impact of COVID-19 on vaccination coverage in indigenous in Brazil

Estimando el impacto de la COVID-19 en la cobertura de vacunación en indígenas de Brasil

**RESUMO**

**Justificativa e Objetivos:** Avaliar o efeito da COVID-19 na cobertura vacinal no Brasil entre populações indígenas. **Métodos:** Trata-se de um estudo ecológico utilizando dados secundários obtidos dos sistemas de informação oficiais brasileiros sobre a taxa de cobertura vacinal da Vacina Meningocócica C Conjugada, Bacillus Calmette-Guérin, Febre Amarela e Vacina Pneumocócica Conjugada 10-valente nas dez localidades com maior população indígena do país entre 2018 a 2022. **Resultados:** Foram encontradas heterogeneidades na cobertura vacinal indígena. Além disso, houve redução de aproximadamente 40%, 24%, 36% e 50% na taxa de cobertura vacinal para a Vacina Meningocócica C Conjugada, Bacillus Calmette-Guérin, Febre Amarela e Vacina Pneumocócica Conjugada 10-valente, respectivamente. **Conclusão:** Nossos achados reforçam a importância da adoção de campanhas de vacinação entre localidades indígenas.

**Descritores:** Sistema de saúde indígena; desigualdades; imunização; Vigilância.

**ABSTRACT**

**Background and Objectives:** To evaluate the effect of COVID-19 on vaccination coverage in Brazil between indigenous populations. **Methods:** This was an ecological study using secondary data obtained from official Brazilian information systems on vaccine coverage rate to Meningococcal C Conjugate, Bacillus Calmette-Guérin, Yellow Fever, and 10-valent Pneumococcal Conjugate Vaccine in the ten localities with the more indigenous populations from 2018 to 2022. **Results:** There were found heterogeneities in indigenous vaccination coverage. Furthermore, there was a reduction in approximately 40%, 24%, 36%, and 50% in the coverage vaccine rate for the Meningococcal C Conjugate, Bacillus Calmette-Guérin, Yellow Fever, and 10-valent Pneumococcal Conjugate Vaccine, respectively. **Conclusion:** Our findings reinforce the importance of adopting vaccination campaigns among indigenous localities.

**Keywords:** Indigenous health system; inequalities; immunization; Surveillance.

**RESUMEN**

**Justificación y Objetivos:** Evaluar el efecto de la COVID-19 en la cobertura de vacunación en Brasil entre poblaciones indígenas. **Métodos:** Se realizó un estudio ecológico utilizando datos secundarios obtenidos de los sistemas de información oficiales brasileños sobre la tasa de cobertura vacunal contra el Meningococo C Conjugado, Bacilo de Calmette-Guérin, Fiebre Amarilla y Neumococo Conjugado 10-valente en las diez localidades con mayor población indígena de 2018 a 2022. **Resultados:** Se encontraron heterogeneidades en la cobertura de vacunación indígena. Además, hubo una reducción de aproximadamente el 40%, 24%, 36% y 50% en la tasa de cobertura de vacunación para la vacuna conjugada contra el meningococo C, el bacilo de Calmette-Guérin, la fiebre amarilla y la vacuna conjugada contra el neumococo 10-valente, respectivamente. **Conclusión:** Nuestros hallazgos refuerzan la importancia de adoptar campañas de vacunación entre las localidades indígenas.

**Palabras Clave:** Sistema de salud indígena; desigualdades; inmunización; Vigilancia.

**INTRODUCTION**

The vaccination is one of the most successful interventions in the history of medicine and is responsible for drastic decrease in the morbidity and mortality associated with many infectious diseases.1-3. In 2010, with the aim that all individuals and communities enjoy lives free from vaccine-preventable diseases was launched the Decade of Vaccines Collaboration that was led by the World Health Organization (WHO), United Nations Children’s Fund (UNICEF), Gavi The Vaccine Alliance, the US National Institute of Allergy and Infectious Diseases (NIAID), and the Bill & Melinda Gates Foundation (BMGF).4 Despite all efforts made until 2019, during the COVID-19 pandemic, the recommendation to remain in isolation and avoid crowding, as well as the fear of contagion by visiting health centers contributed to reducing vaccination coverage in the world. 2, 5

Brazil’s National Immunization Program (NIP) was created in 1973, aiming to provide universal access to several vaccines in order to control the escalation of infectious diseases and reduce childhood mortality rates. Additionally, the NIP providing vaccines free of charge to the whole population through the public health system.2 Many countries have recorded a substantial drop in the routine vaccination schedules in children due to the ongoing COVID-19 pandemic, especially children under 2 years of age.2, 6, 7

Brazil has a large and diverse population of indigenous people, comprising approximately 896,917 individuals divided into 305 ethnicities that live in both urban and rural areas. Indigenous populations have to deal with many social inequalities resulting from socio-economic marginalization, including poor nutrition, lack of access to health services and proper sanitation.8 All these findings highlight the importance of immunization in indigenous populations. The aim of our study is to assess the early impact of COVID-19 on vaccine coverage rate to Meningococcal C Conjugate (MCC), Bacillus Calmette-Guérin (BCG), Yellow Fever (YF), and 10-valent Pneumococcal Conjugate Vaccine (PCV10) in the ten localities with the more indigenous populations in Brazil.

**METHODS**

A time-series analysis study was conducted among the indigenous populations, through retrospective analysis of immunization reported by the Department of Informatics of the Brazilian Ministry of Health. Data collected through this system include all vaccination schedules and dosage details. These data were accumulated by diverse health professionals. The early impact of the COVID-19 pandemic on the vaccine coverage rate was estimated by comparing the data obtained between the pre-pandemic (2018 and 2019), the pandemic (2020 and 2021) and post-pandemic (2022) periods. Furthermore, previous vaccine coverage (2018) was also retrieved with the aim to provide more consistent data. We estimate the coverage vaccine rate for the following vaccines: MCC, BCG, YF, and PCV10. The vaccine coverage rate was calculated by dividing the number of people that completed the vaccination plan by the target population, multiplied by 100. 2, 9 The localities with the higher number of indigenous populations were identified according to the Brazilian Institute of Geography and Statistics (IBGE) database.

**RESULTS**

The aim of this study was to evaluate the early impact of COVID-19 on immunization coverage among indigenous populations in Brazil. The vaccine coverage for MCC, PCV10, BCG and YF are shown in Table 1. We compared the coverage vaccine rate during pre-pandemic (2019) and the early pandemic period (2022) when the vaccines which prevent to COVID-19 were available and campaigns to promote vaccination were adopted. In overall, during this period there was a reduced in approximately 40%, 24%, 36% and 50% in the coverage vaccine rate the MCC, BCG, YF and PCV10, respectively.

Table 1. Vaccination coverage rate in localities with the higher number of the indigenous populations in Brazil from 2018.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Vaccine | Locality | Vaccination coverage rates (%) by year | | | |  | |
| 2018 | 2019 | 2020 | 2021 | 2022 |
| MCC | São Gabriel da Cachoeira | 73.4 | 132.3 | 50.3 | 32.7 | 42.7 | |
| São Paulo de Olivença | 102.3 | 94.4 | 33.9 | 18.1 | 27.9 | |
| Tabatinga | 85.1 | 96.6 | 84.3 | 76.3 | 65.9 | |
| São Paulo | 86.7 | 86.2 | 76.2 | 67.2 | 67.3 | |
| Santa Isabel do Rio Negro | 109.1 | 70.8 | 56.8 | 67.4 | 62.5 | |
| Benjamin Constant | 94.7 | 114.7 | 48.7 | 32.6 | 39.4 | |
| Pesqueira | 109.2 | 96.1 | 55.3 | 59.1 | 72.6 | |
| Boa Vista | 77.7 | 99.3 | 93.8 | 62.7 | 69.2 | |
| Barcelos | 62.2 | 58.6 | 43.9 | 35.3 | 31.4 | |
| São João das Missões | 100.0 | 118.2 | 98.5 | 78.5 | 58.8 | |
| BCG | São Gabriel da Cachoeira | 109.0 | 119.8 | 48.7 | 44.4 | 53.1 | |
| São Paulo de Olivença | 116.1 | 98.0 | 40.1 | 18.4 | 39.8 | |
| Tabatinga | 114.0 | 98.5 | 96.8 | 94.8 | 93.3 | |
| São Paulo | 99.5 | 77.7 | 63.1 | 60.8 | 62.8 | |
| Santa Isabel do Rio Negro | 115.4 | 78.1 | 60.5 | 73.9 | 64.1 | |
| Benjamin Constant | 105.2 | 141.0 | 87.0 | 37.3 | 22.9 | |
| Pesqueira | 115.1 | 99.3 | 72.1 | 79.9 | 98.7 | |
| Boa Vista | 144.0 | 136.1 | 124.6 | 110.3 | 112.1 | |
| Barcelos | 77.0 | 72.0 | 47.3 | 41.6 | 42.0 | |
| São João das Missões | 59.8 | 63.3 | 101.9 | 105.7 | 110.2 | |
| Yellow Fever | São Gabriel da Cachoeira | 68.3 | 81.0 | 37.8 | 26.6 | 33.3 | |
| São Paulo de Olivença | 105.8 | 86.3 | 20.6 | 10.2 | 23.1 | |
| Tabatinga | 99.5 | 87.0 | 72.5 | 63.9 | 51.8 | |
| São Paulo | 55.9 | 76.0 | 69.2 | 63.0 | 60.5 | |
| Santa Isabel do Rio Negro | 89.3 | 67.3 | 39.2 | 48.8 | 43.1 | |
| Benjamin Constant | 101.0 | 114.8 | 44.9 | 25.0 | 34.9 | |
| Pesqueira | 12.4 | 14.3 | 30.2 | 42.4 | 59.5 | |
| Boa Vista | 68.6 | 80.5 | 54.9 | 41.2 | 44.3 | |
| Barcelos | 51.4 | 41.4 | 38.6 | 21.9 | 22.7 | |
| São João das Missões | 92.6 | 115.1 | 100.4 | 73.6 | 50.4 | |
| PCV10 | São Gabriel da Cachoeira | 106.4 | 118.9 | 46.3 | 38.0 | 43.7 | |
| São Paulo de Olivença | 110.3 | 97.0 | 31.1 | 18.1 | 29.6 | |
| Tabatinga | 88.3 | 92.7 | 85.7 | 75.1 | 72.3 | |
| São Paulo | 94.3 | 87.7 | 76.8 | 68.7 | 67.9 | |
| Santa Isabel do Rio Negro | 104.0 | 86.0 | 63.0 | 71.1 | 63.7 | |
| Benjamin Constant | 98.3 | 120.3 | 52.3 | 35.7 | 39.9 | |
| Pesqueira | 110.3 | 95.2 | 58.1 | 63.7 | 75.9 | |
| Boa Vista | 88.7 | 105.2 | 102.3 | 67.3 | 74.8 | |
| Barcelos | 73.0 | 58.4 | 47.1 | 38.3 | 33.2 | |
| São João das Missões | 104.1 | 113.3 | 103.8 | 83.7 | 62.0 | |

MCC: Meningococcal C Conjugate Vaccine, BCG: Bacillus Calmette-Guérin; YF: Yellow Fever; PCV10: 10-valent Pneumococcal Conjugate Vaccine. Data obtained from Department of Informatics of the Brazilian Ministry of Health.

Considering data obtained during pandemic period the locality of Boa vista achieved 100% of vaccine coverage rate to PCV10 in 2020 and to BCG in 2020, 2021 and 2022. In São Paulo de Olivença approximately 18% of coverage vaccine rate was reported for MCC, BCG and PCV10 in 2021. Moreover, only 10.2% of coverage vaccine to YF was achieved in the same period and locality. In general, there was a decrease in the immunization in all vaccines evaluated in this study when compared to data from 2020 to 2021. Fluctuations between 20.6% to 100% and 10.2% to 100% in vaccine coverage rates were found in 2020 and 2021, respectively.

There was a reduction the almost 80% on coverage vaccine when compared data the 2019 to 2022 in at least one locality for each immunization analyzed. While in 2018 many localities achieve 100% of coverage vaccine in 2022 only Boa Vista and São João das Missões obtained the same coverage for BCG vaccine.

**DISCUSSION**

Since March 2020, Brazil has been strongly affected by COVID-19 pandemic, mainly vulnerable populations as indigenous. 10 In this context of pandemic, due to measures of social distancing to mitigate the transmission of the virus many countries registered a substantial reduction in vaccination coverage. Here, we observed an important drop in the immunization over time across this study.

In England, there was a reduction of 19.8% in the doses of the measles-mumps-rubella vaccine during the COVID-19 pandemic period.11 It has been reported that In the United States, the decrease in vaccine coverage began the week after the pandemic and this decrease were higher among children under two years old. 12 Also, in United States a paper showed that the vaccinal coverage, for all recommended vaccines, dropped from 67.0% to 49.7% among 5 months old children.6 Moreover, the vaccine that protects against measles, diphtheria, and tetanus decreased in coverage in Indonesia. 7

In a previously study, we evaluated the impact of COVID-19 in the MCC, BCG the triple bacterial vaccine (DTaP), and PCV10 immunization in Brazil and we found a drop around 10 to 20% from 2019 to 2020 period. When we evaluated the coverage vaccine by region, we found that Northern and Northeast regions was responsible by the higher decline levels of coverage by approximately 20%. In order to evaluate the same impact in indigenous populations we collected data from the ten localities with the highest number of indigenous people in the country. There was more than 55% of reduction in the coverage vaccine rate to MCC in almost half of localities analyzed. Furthermore, in São Paulo de Olivença this reduction was at least 70% for all vaccines which we evaluated.

These results clearly showed that these reductions in the immunization were higher than observed in our previously study already mentioned. Moreover, was also higher than another study that showed a decrease of 27% in the first dose of the pentavalent vaccine applied in March 2020 when compared to March 2019 in Brazil.5 It is important to consider that indigenous communities often have minimal access to clean water and public sanitation. Furthermore, local medical services are scarce or non-existent for remote rural communities. These issues reinforce the necessity to achieved higher vaccine coverage rate to prevent different infectious diseases. A study that evaluated the increased vulnerability to SARS‑CoV‑2 infection among indigenous people living in the urban area of Manaus reported that the majority of the population adopted distancing measures during the pandemic.8 The fear of contagious by COVID-19 could explain, at least in part de lower immunization in the 2020 period. However, it is also important to consider that overall, in 2021 when indigenous people had already been immunization against COVID-19 the coverage vaccine rate was lower than observed in 2020. These data suggest that COVID-19 maybe was not the only problem that was associated with lower immunization rates. According to Menezes and colleagues, other reasons must be considered besides non-adherence to vaccination due to the pandemic, such as fear of vaccine side effects, lack of knowledge regarding its benefits, and difficulties to visit the health post. 13 Moreover, reactions to governments, as well as cultural and religious issues, have also been reported in a systematic review that analyzed vaccine hesitancy in Latin America and Africa. 15

A few limitations of this study should be mentioned. Firstly, Brazil has an important national net system which is based on different databanks that was used in this paper. However, secondary data often have inconsistencies and are subject to underreporting. Second, we used data from ten localities with more indigenous people in Brazil because data that refer to vaccine coverage rate there are not only for indigenous populations. Thus, we assumed that the coverage vaccine is the same for indigenous and non-indigenous groups in these localities. One of the main strengths of this paper is that to our knowledge this is the first study to evaluated, in indigenous people the impact of the COVID-19 pandemic in the coverage of several important vaccines in Brazil. Furthermore, we used the latest available data for coverage vaccine rate in the country.

In the COVID-19 pandemic the WHO estimated that at least 80 million children would be susceptible to preventable infectious diseases as measles, diphtheria, and polio due to of the decrease in vaccination coverage. In addition, it has been reported that this impact would be even more important in families with unfavorable socioeconomic conditions as indigenous populations.2, 5 To identify the really cause of reduction in the immunizations is urgent in indigenous localities. Our results highlight the importance to promote vaccinations campaign because immunization in one of the main strategies to combat inequality in the development countries.2

**REFERENCE**

1. Stein RA. The golden age of anti-vaccine conspiracies. Germs. 2017;7(4):168-70.  <https://doi.org/10.18683/germs.2017.1122>

2. Silveira MM, Conrad NL, Leivas Leite FP. Effect of COVID-19 on vaccination coverage in Brazil. Journal of medical microbiology. 2021;70(11). [https://doi.org/](https://doi.org/10.15649/cuidarte.v7i2.339)10.1099/jmm.0.001466

3. Zhang H, Patenaude B, Zhang H, Jit M, Fang H. Global vaccine coverage and childhood survival estimates: 1990-2019. Bulletin of the World Health Organization. 2024;102(4):276-87. <https://doi.org/10.2471/BLT.23.290129>

4. MacDonald N, Mohsni E, Al-Mazrou Y, Kim Andrus J, Arora N, Elden S, et al. Global vaccine action plan lessons learned I: Recommendations for the next decade. Vaccine. 2020;38 (33):5364-71. <https://doi.org/10.1016/j.vaccine.2020.05.003>

5. Sato APS. Pandemic and vaccine coverage: challenges of returning to schools. Revista de saude publica. 2020;54:115. <https://doi.org/10.11606/s1518-8787.2020054003142>

6. Bramer CA, Kimmins LM, Swanson R, Kuo J, Vranesich P, Jacques-Carroll LA, et al. Decline in Child Vaccination Coverage During the COVID-19 Pandemic - Michigan Care Improvement Registry, May 2016-May 2020. MMWR Morbidity and mortality weekly report. 2020;69(20):630-1. <http://dx.doi.org/10.15585/mmwr.mm6920e1>

7. Suwantika AA, Boersma C, Postma MJ. The potential impact of COVID-19 pandemic on the immunization performance in Indonesia. Expert review of vaccines. 2020;19(8):687-90. [https://doi.org/](https://doi.org/10.15649/cuidarte.v7i2.339)10.1080/14760584.2020.1800461

8. Pontes GS, de Melo Silva J, Pinheiro-Silva R, Barbosa AN, Santos LC, de Padua Quirino Ramalho A, et al. Increased vulnerability to SARS-CoV-2 infection among indigenous people living in the urban area of Manaus. Scientific reports. 2021;11(1):17534. <https://doi.org/10.1038/s41598-021-96843-1>

9. Andrade AL, Minamisava R, Tomich LM, Lemos AP, Gorla MC, de Cunto Brandileone MC, et al. Impact of meningococcal C conjugate vaccination four years after introduction of routine childhood immunization in Brazil. Vaccine. 2017;35(16):2025-33. [https://doi.org/](https://doi.org/10.15649/cuidarte.v7i2.339)10.1016/j.vaccine.2017.03.010

10. Santos VS, Souza Araujo AA, de Oliveira JR, Quintans-Junior LJ, Martins-Filho PR. COVID-19 mortality among Indigenous people in Brazil: a nationwide register-based study. Journal of public health. 2021;43(2):e250-e1. <https://doi.org/10.1093/pubmed/fdaa176>

11. McDonald HI, Tessier E, White JM, Woodruff M, Knowles C, Bates C, et al. Early impact of the coronavirus disease (COVID-19) pandemic and physical distancing measures on routine childhood vaccinations in England, January to April 2020. Euro surveillance : bulletin Europeen sur les maladies transmissibles = European communicable disease bulletin. 2020;25 (19). <https://doi.org/10.2807/1560-7917.ES.2020.25.19.2000848>

12. Santoli JM, Lindley MC, DeSilva MB, Kharbanda EO, Daley MF, Galloway L, et al. Effects of the COVID-19 Pandemic on Routine Pediatric Vaccine Ordering and Administration - United States, 2020. MMWR Morbidity and mortality weekly report. 2020;69(19):591-3. <https://doi.org/10.15585/mmwr.mm6919e2>

13. Menezes AMB, Hallal PC, Silveira MF, Wehrmeister FC, Horta BL, Barros AJD, et al. Influenza vaccination in older adults during the COVID-19 pandemic: a population-based study in 133 Brazilian cities. Ciencia & saude coletiva. 2021;26(8):2937-47. [https://doi.org/](https://doi.org/10.15649/cuidarte.v7i2.339)10.1590/1413-81232021268.09382021

14. Takahashi S, Metcalf CJ, Ferrari MJ, Moss WJ, Truelove SA, Tatem AJ, et al. Reduced vaccination and the risk of measles and other childhood infections post-Ebola. Science. 2015;347(6227):1240-2. <https://doi.org/10.1126/science.aaa3438>

15. Matos C, Goncalves BA, Couto MT. Vaccine hesitancy in the global south: Towards a critical perspective on global health. Global public health. 2022;17(6):1087-98. https://doi.org/10.1080/17441692.2021.1912138