

Decline of COVID-19 Pandemic: Impacts of Vaccination in Brazil

Helena Souza da Hora^{1*}, Larissa Moraes dos Santos Fonseca², Bruna Aparecida Souza Machado²

¹Industrial Technological Development Scholarship (DTI-B); ² SENAI Institute of Innovation in Advanced Health Systems. SENAI CIMATEC University Center; Salvador, Bahia, Brazil

The COVID-19 pandemic emerged unexpectedly and devastated, surprising the world quickly with the accelerated growth in cases and deaths caused by SARS-CoV-2 infection. As a strategy to face the pandemic, developing safe and effective vaccines fast was a great challenge for the scientific community and the big pharmaceutical companies. However, some factors enabled the production of vaccines soon authorized for emergency use by the WHO. In Brazil, the positive impacts of vaccination did not take long to appear, revealing a drop in the number of cases, mainly in the number of deaths caused by the disease a few months after the immunization campaign. Keywords: Vaccination. Pandemic. COVID-19. Brazil.

Introduction

The spread of SARS-CoV-2, which originated in Wuhan, China, in December 2019, evolved at an accelerated pace, reaching hundreds of countries in all continents quickly. In March 2020, the World Health Organization (WHO) officially declared a pandemic, the first caused by a coronavirus [1]. Severe acute respiratory syndrome 2 (SARS-CoV-2) has caused, in addition to acute respiratory symptoms, systemic effects, such as neurological, digestive, intestinal, and sensory symptoms [2]. According to the WHO, it is estimated that 15% of the population infected by the virus develops a severe form of the disease requiring oxygen, and 5% require intensive care [3].

The vertiginous growth of severe cases of the disease indicates the lethal potential of SARS-CoV-2, which since January 2020 to date has caused the death of 6.87 million people worldwide, with more than 600 million confirmed cases. Brazil, no different, gained prominence in the

world, presenting high numbers, with approximately 700 thousand deaths and 37.14 million cases [4]. Faced with this alarming scenario for public health, authorities, pharmaceutical industries, and the scientific community worldwide have sought to adopt strategies to combat the COVID-19 pandemic. Efficient and safe vaccines stand out as a priority measure to prevent new cases and reduce the lethality rate caused by the virus. The accelerated development of vaccines in times of health crisis was essential for the early start of immunization of the world population since regular vaccine production takes an average of 8 to 20 years [5]. The global effort and targeted funding enabled the first COVID-19 vaccines to be produced within months, with approval for emergency use by regulators and the WHO. Despite the speedy process, compliance with the stages involved in the development of a vaccine was maintained: the preclinical phase, developed in animals or *in vitro*; the phase 1 clinical trial, developed in a group of dozens of people to test safety, dose, and immune response; the phase 2 clinical trial, carried out in a group of hundreds of people to confirm the safety data and the immunological response of the vaccine; the phase 3 clinical trial, to prove the drug's safety and efficacy in thousands of people; the approval stage of the responsible Regulatory Agency; and finally, large-scale production. The combination or concomitant conduction of the clinical trial phases justifies the shortening of production time during the pandemic [6], like Pfizer/BioNTech, produced in just 10 months [7].

Received on 15 March 2023; revised 27 May 2023.

Address for correspondence: Helena Souza da Hora. Avenida Orlando Gomes, 1845, Piatã. Salvador, Bahia, Brazil. Zipcode: 41650-010. E-mail: helena.hora@fbter.org.br. Study presented in the VIII Scientific and Technological Research Evaluation Seminar and VII Workshop on Integration and Training in High Performance Processing. DOI 10.34178/jbth.v6i2.299.

J Bioeng. Tech. Health 2023;6(2):170-173
© 2023 by SENAI CIMATEC. All rights reserved.

In March 2021, just one year into the pandemic, we already had 3 vaccines approved on the WHO emergency use list [5]. However, the moment's urgency alone was insufficient to achieve such success. The production of effective and safe vaccines in a short period was possible due to several factors, including prior knowledge of the SARS virus due to previous epidemics, the sequencing of the SARS-CoV-2 genome, and the use of technological platforms directed to other diseases [8]. Today, are 50 vaccines approved in the world against COVID-19, 183 clinical studies are being conducted, and 199 candidates in preclinical studies, the vast majority, protein subunit vaccines and RNA vaccines [9].

In Brazil, the vaccination campaign started in January 2021, practically a month after the start of most countries, and despite the uncertainties about the adverse effects, making it impossible for the population to accept them completely, these are still statistically insignificant when compared to the benefits generated for vaccination [10]. This review aims to identify and relate the impacts of vaccination with the number of cases and deaths during the COVID-19 pandemic in Brazil.

Materials and Methods

The study is a literature review of the positive impacts caused by vaccination against COVID-19 in Brazil through the observation and relationship of epidemiological indicators. In addition to the active search for related publications on the international Pubmed research platform, a collection was also carried out in the Our World in Data database. The indicator numbers of cases, deaths, and people vaccinated with the complete initial protocol were collected and analyzed, comparing the period from February 2020 to February 2023.

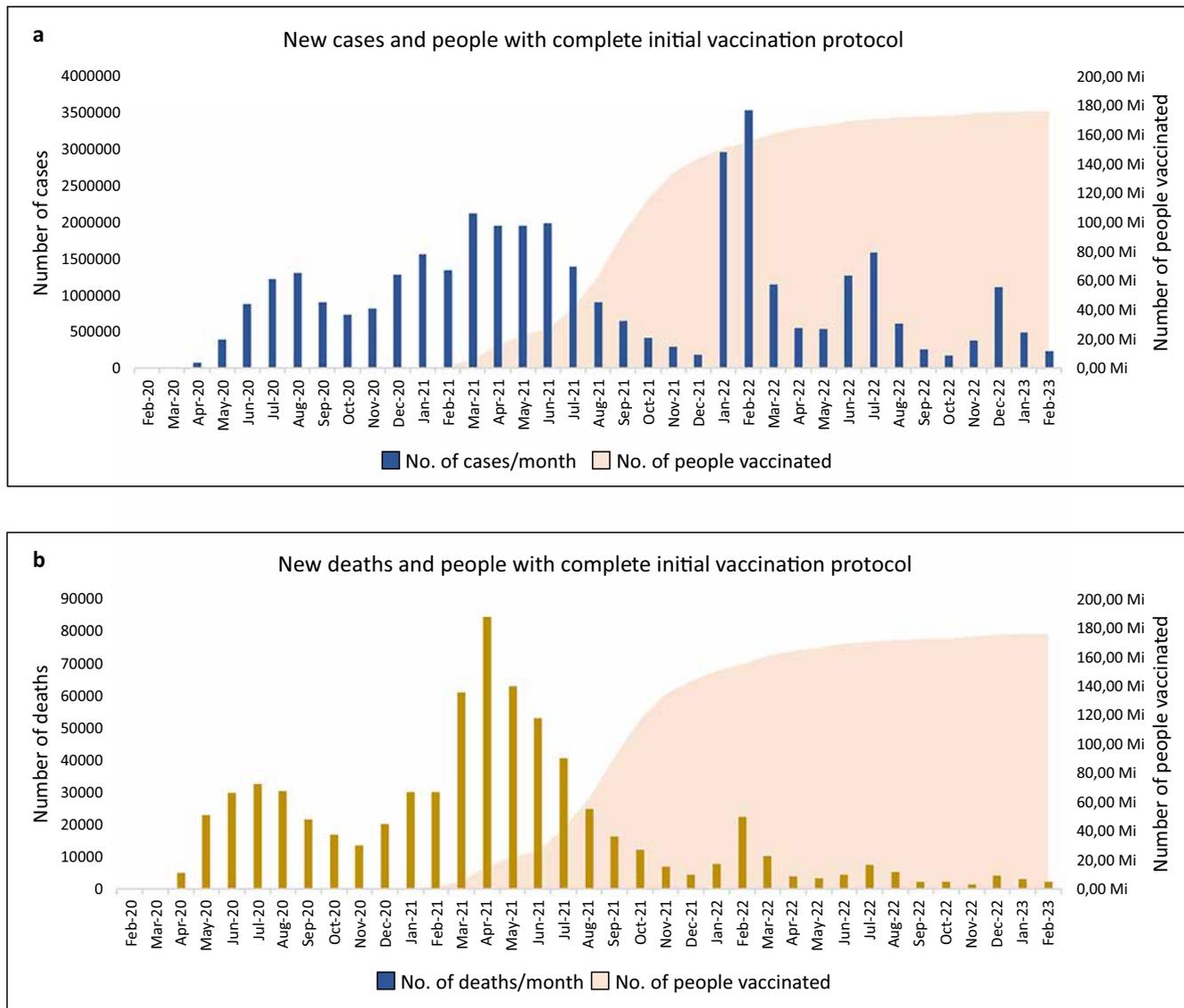
Literature Review and Discussion

Since the arrival of COVID-19 in Brazil, the country has reproduced the accelerated growth of

cases and deaths experienced in other countries. Brazil registered its first case in February 2020, and the first death due to SARS-CoV-2 infection occurred shortly after that, on March 12 [11]. Vaccination began in January 2021, almost a year later, and it was already significantly reflected in the alarming numbers caused by the coronavirus [12]. The year 2020 accumulated more than 190,000 deaths and 7.5 million cases. In 2021, it has surpassed the previous one in total numbers, with more than 420,000 deaths and 14.7 million cases. However, for the first time since the outbreak of the first wave, a continuous decline in the number of cases was observed (Figure 1A), mainly in the number of deaths from April to December 2021 (Figure 1B). At that point, Brazil already had 143.4 million people vaccinated with the initial protocol (two doses) completed, equivalent to 67% of the population. In order to achieve herd immunity, that is, to immunize a sufficient number of individuals to contain the spread of the virus and indirectly protect vulnerable people, it would be necessary to have 70% of the population vaccinated [13]. The congruence of these data confirms the responsibility and prominence of vaccinating the stop the COVID-19 transmission chain, resulting in a noticeable reduction in cases and deaths during the last half of 2021 (Figure 1). Studies developed in other countries in the last two years have shown the same effect caused by vaccination. Between 2020 and 2021, vaccination would have prevented the deaths of 14.4 million people in 185 countries [14]. In fully vaccinated populations, vaccination efficacy was observed in 89.1% of infections, 97.2% of hospitalizations, 97.4% of ICU admissions, and 99% of deaths [15]. In Brazil, vaccination would have prevented the daily death of approximately 500 people in the first months of 2021 [16].

Despite the considerable reduction observed in numbers in mid-2021, the beginning of 2022 was marked by a new outbreak and a peak in new confirmed cases (Figure 1A). The second wave, subtly started in November of the previous year by the Gamma variant (P.1 lineage) [17], became

Figure 1. Relationship between the number of people vaccinated and the number of new cases and deaths caused by COVID-19, in Brazil, from February 2020 to February 2023.



(a) Relationship between the number of new cases per month, and the cumulative number of people vaccinated with a complete initial immunization protocol, from February 2020 to February 2023. (b) Relationship between the number of new deaths per month and a cumulative number of people vaccinated with initial complete immunization protocol from February 2020 to February 2023.

Source: Authors (2023)

evident in January and February 2022, with new 2.95 million and 3.53 million cases, respectively.

However, the number of deaths, fortunately, did not follow the same growth rate, with just over 30,000 deaths in the two months, a very different scenario from that observed in the most painful period before vaccination. March and April 2021 stood out as the worst

pandemic scenario; they were responsible for 4.06 million cases and more than 145 thousand deaths. The comparison of epidemiological indicators during these two periods (before and after the effects of vaccination) reflects vaccine efficiency, which, despite not preventing infection by the virus and its variants, prevents severe cases and deaths caused by the disease.

Conclusion

The benefits brought by vaccines are unquestionable. The eradication of diseases such as smallpox and polio confirms the importance of vaccination. According to WHO, preventable diseases prevent up to 3 million deaths annually. Likewise, early immunization during the COVID-19 pandemic has demonstrated its positive impacts on a global scale, reducing the severity of the symptoms triggered by the SARS-CoV-2 infection and, above all, preventing the deaths of thousands of people. Currently, at least 186.83 million people in Brazil are vaccinated with at least one dose [4]. The relationship between this index and the reduction in the number of cases and deaths registered in recent months proves the current control of the epidemiological situation in the country and the efficiency of the vaccines used, capable of stimulating and strengthening the immune system of individuals. However, the global interest in interrupting the virus's spread requires mass vaccination adherence. Therefore it is necessary to inform the population of its benefits and impacts to make everyone aware of its importance.

References

1. WHO, Director-General's opening remarks at the media briefing on COVID19 - March 2020. WHO Director-General's opening remarks at the media briefing on COVID-19 - 11 March 2020. Accessed: March 27, 2023.
2. Adil T, Rahman R, Whitelaw D, Jain V, Al-Taani O, Rashid F, Munasinghe A, Jambulingam P. SARS-CoV-2 and the pandemic of COVID-19. *Luton: Postgrad Med J* 2020.
3. Quais são os sintomas de alguém infectado com COVID-19? <https://www.paho.org/pt/covid19-collapse-accordion-24199-3>. Accessed: March, 22 2023.
4. WHO. Situação epidemiológica. <https://covid19.who.int/region/amro/country/br>. Accessed: April 3, 2023.
5. Pischel L, Yildirim I, Omer SB. Fast development of high-quality vaccines in a pandemic. *Chest*. 2021 Jul;160(1):e1-e3. Doi: 10.1016/j.chest.2021.03.063. Epub 2021 Apr 20. PMID: 33848535; PMCID: PMC8102080.
6. Vaccine Research & Development. <https://coronavirus.jhu.edu/vaccines/timeline>. Accessed: March 20, 2023.
7. Costa C, Tombesi C. Gráfico mostra tempo que humanidade levou para criar vacinas e recorde para covid-19. <https://www.bbc.com/portuguese/internacional-55232520>. Accessed: March 26, 2023.
8. COVID-19 vaccine tracker. <https://covid19.trackvaccines.org/vaccines/approved/#vaccine-list>. Accessed: March 31, 2023.
9. WHO. COVID-19 vaccine tracker and landscape. Disponível em: <https://www.who.int/publications/m/item/draft-landscape-of-covid-19-candidate-vaccines> Accessed: March 31, 2023.
10. Chavda VP, Yao Q, Vora LK, Apostolopoulos V, Patel CA, Bezbaruah R, Patel AB, Chen ZS. Fast-track development of vaccines for SARS-CoV-2: The shots that saved the world. *Front Immunol* 2022 Oct 3;13:961198. doi: 10.3389/fimmu.2022.961198. PMID: 36263030; PMCID: PMC9574046.
11. Primeira morte por Covid-19 no país ocorreu em 12 de março em SP, diz ministério. <https://www.cnnbrasil.com.br/saude/primeira-morte-por-covid-19-no-pais-ocorreu-em-12-de-marco-em-sp-diz-ministerio/>. Accessed: March 25, 2023.
12. Programa Nacional de Imunizações – PNI. <https://www.gov.br/saude/pt-br/coronavirus/vacinas/pni>. Accessed: April 3, 2023.
13. Siqueira PC, Cola JP, Comerio T, Sales CMM, Maciel EL. Limiar de imunidade de rebanho para SARS-CoV-2 e efetividade da vacinação no Brasil. *Vitória: J Bras Pneumol* 2022. Doi: 10.36416/1806-3756/e20210401.
14. Watson OJ, Barnsley G, Toor J, Hogan AB, Winskill P, Ghani AC. Global impact of the first year of COVID-19 vaccination: A mathematical modelling study. *London: The Lancet Infectious Diseases* 2022; June 23. Doi: [https://doi.org/10.1016/S1473-3099\(22\)00320-6](https://doi.org/10.1016/S1473-3099(22)00320-6).
15. Zheng C, Shao W, Chen X, Zhang B, Wang G, Zhang W. Real-world effectiveness of COVID-19 vaccines: a literature review and meta-analysis. *Henan: International Int J Infect Dis* 2022 Jan;114:252-260. Doi: 10.1016/j.ijid.2021.11.009. Epub 2021 Nov 17. PMID: 34800687; PMCID: PMC8595975.
16. Estudo inédito revela que para cada R\$ 1 investido em vacinas durante a pandemia, gerou-se um impacto positivo de R\$ 9 no PIB. <https://www.pfizer.com.br/noticias/ultimas-noticias/o-impacto-socioeconomico-das-vacinas-durante-a-pandemia-de-COVID-19>. Accessed: April 4, 2023.
17. de Souza FSH, Hojo-Souza NS, da Silva CM, Guidoni DL. Second wave of COVID-19 in Brazil: younger at higher risk. *Eur J Epidemiol* 2021 Apr;36(4):441-443. Doi: 10.1007/s10654-021-00750-8. Epub 2021 Apr 21. PMID: 33881666; PMCID: PMC8058142.