Original Article

Vaccination against COVID-19 in national territory

Vacinação contra a COVID-19 em território nacional

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ABSTRACT | OBJECTIVE: To analyze the vaccination against COVID-19 through the records in the national territory in the period from 2021 to 2022. **MATERIALS:** It consists in an ecological descriptive retrospective study, in which the collection of information was held in May 2022, extracted from the LocalizaSUS portal, via the Vacinômetro-SUS panel, in the period of January 17, 2021, to May 21, 2022. **RESULTS:** On May 21, 2022, Brazil presented, through the Ministry of Health panel about COVID-19, 429.803.859 doses were administered, clarifying the COVID-19 vaccination progress in the national territory. The data collected identified a higher vaccination rate in females (53,3%), in young adults between 20 e 59 years of age (64,1%), and lower values in the population over 60 years (21,6%). Considering the geographical division, the southeast region of the country presents a higher number of administered doses against COVID-19 (353.197.267 doses), and concerning the federative units, the state of São Paulo precedes the others in this aspect. **CONCLUSION:** The application of the vaccines against COVID-19 in the Brazilian states is heterogeneous. Despite these facts, the study verifies that Brazil obtained a satisfactory result in the vaccinal progress against COVID-19 in all national territory.

KEYWORDS: Vaccination coverage. Vaccines. Coronavirus. Social stigma. Social Determinants of Health.

RESUMO | OBJETIVO: Analisar a vacinação contra a CO-VID-19, por meio dos registros em território nacional, no período de 2021 a 2022. **MATERIAIS:** Trata-se de um estudo ecológico descritivo retrospectivo, cujo levantamento das informações foi realizado em maio de 2022, extraídos do portal LocalizaSUS, por meio do painel Vacinômetro-SUS, no período de 17 de janeiro de 2021 até 21 de maio de 2022. **RESULTADOS:** Em 21 de maio de 2022 o Brasil mostrou, através do painel do Ministério da Saúde sobre a vacinação contra COVID-19, 429.803.859 doses aplicadas, elucidando a evolução da vacinação da COVID-19 em território nacio-nal. Os dados levantados identificaram maior número de aplicações no sexo feminino (53,3%), em adultos jovens na faixa etária entre 20 e 59 anos (64,1%) e valores menores na vacinação referente à população maior de 60 anos (21,6%). Ao considerar as divisões geográficas, a região sudeste apresenta o maior quantitativo de doses aplicadas contra a COVID-19 (353.197.267 doses) e, em relação as unidades federativas, o estado de São Paulo precede as demais no quesito. **CONCLUSÃO:** A aplicação das vacinas contra a CO-VID-19, nos estados brasileiros é heterogênea. Mesmo dian-te destes fatos, o estudo comprovou que o Brasil obteve re-sultado satisfatório na evolução vacinal contra a COVID-19 em todo o território nacional.

PALAVRAS-CHAVE: Cobertura vacinal. Vacinas. Coronavírus.

Introduction

The pandemic caused by the new coronavirus 2019 (COVID-19) became one of the major challenges of the 21st century. Nowadays, until mid-May 2022, there have been approximately 521 million confirmed cases of the disease worldwide, including 6,2 million deaths. In Brazil, the confirmed cases exceeded 30,7 million, and 665 thousand of those perished.[1]

By the first quarter of 2020, SARS-CoV-2 had spread globally, impacting thousands of lives. Soon, the World Health Organization (WHO) defined the scenario as the COVID-19 pandemic and began to implement measures to try to prevent the transmission of the new coronavirus. In addition to the use of a mask, social isolation, and hand hygiene, the race to create vaccines also began; immunize the population and fight infection.[2]

In order to reduce the spread of this virus and end the pandemic, scientists around the world worked to develop efficient and safe vaccines in record time to combat the pathogen. In early 2021, the Agência Nacional de Vigilância Sanitária - ANVISA (National Health Surveillance Agency) authorized the emergency use of two vaccines in Brazilian territory, culminating in the vaccination of Mônica Calazans, an ICU nurse in the city of São Paulo, the first person vaccinated in Brazilian national territory.[3]

Due to the initial shortage of vaccine supply and focusing on reducing the mortality generated by SARS-CoV-2, the Programa Nacional de Imunização - PNI (National Immunization Program) defined the priority groups to be vaccinated. Then, it became evident that people of older age groups, people with diabetes mellitus, chronic kidney disease, lung diseases, and/or heart diseases were more susceptible to severe cases of COVID-19 and death from the infection. In addition, health professionals who were at the forefront of care in the pandemic, being more exposed to contamination due to their work nature, were also included as a priority, thus valuing the principle of reciprocity.[4]

In Brazil, four vaccines were approved by ANVISA and used on a large scale: Pfizer/BioNTech, in which a messenger RNA of the virus was developed; AstraZeneca/Oxford, which contains SARS-CoV-2 structural surface glycoprotein; Janssen/ Johnson & Johnson, which has in its active principle a recombinant DNA and CoronaVac/Sinovak Life Sciences, characterized by presenting the inactivated virus.[5]

Thus, this study has as a pretense the potential to provide a better evaluation of the vaccination coverage against the new coronavirus in Brazil, as well as guide other research concerning this topic trough scientific background. Therefore, considering the relevance of mass vaccination, in order to face the magnitude of this pandemic, the study aimed to analyze the vaccination against COVID-19, through the national territory registries, in the period from 2021 to 2022.

Methods and materials

This is an ecological, retrospective health data study. The information collection was conducted in May 2022, extracted from the *LocalizaSUS* portal, through the *Vacinômetro-SUS* portal, available online.[6]

The study population was elected through the vaccination program registries captured by the Rede Nacional de Dados em Saúde - RNDS (National Health Data Network) and monitored by the Secretaria de Vigilância Sanitária - SVS (Secretary of Health Surveillance) in the period from January 17, 2021, to May 21, 2022. The variables investigated were the daily vaccination registries, according to the federated units, macro-regions, gender, and age.

The following inclusion criteria were used: all vaccination doses registered in the *Vacinômetro-SUS* panel; data made available by the Ministry of Health. All doses awaiting registration on the platform were excluded. Data were organized and processed by the Microsoft Excel® program, a software in which descriptive statistical analysis and calculation of the ratio between vaccination and sex were performed.

This research was carried out with secondary epidemiological data of public and free access, indexed in the *LocalizaSUS*, available online for analysis and evaluation of the records of the vaccination program against COVID-19 in the national territory. Thus, it is exempted from evaluation by the Research Ethics Committee, as described in Resolution No. 510/2016 of the National Health Council.

Results

Brazil presented, on May 21, 2022, via the Health Ministry COVID-19 vaccination panel, 429.803.859 doses were administered. From this number, 176.651.705 regarding the first dose, 158.183.690 regarding the second dose, 4.874.225 single doses, and 90.094.228 regarding booster and additional doses.

As for the distribution by sex, it was observed that 228,957,595 (53.3%) of the vaccines were administered to women and 200,842,114 (46.7%) to men, as shown in Table 1.

Table 1. Distribution of doses against COVID-19 applied, according to sex. Brazil - 2022

|	N	%
Male	200842114	46,7%
Female	228957595	53,3%
Other	4150[1]	0,0%[2]

Source: Rede Nacional de Dados da Saúde - RNDS (National Health Data Network)
Note[1]: 4150 vaccinated people have no defined sex
[2]Very small percentage (0.000965556709903808%)

Graph 1 shows the distribution of doses applied per age group. Individuals aged 5 to 11 years account for 19,258,721 (4.5%) of the doses applied; in turn, individuals aged 12-19 total 42,458,036 (9.9%). For the adult population (20-59 years old), 275,394,046 (64.1%) were applied, whereas, for the elderly population (≥ 60 years old), there was an application of 31,333,793 (21.6%).

Graph 1. Distribution of doses against COVID-19 applied, according to age group. Brazil - 2022
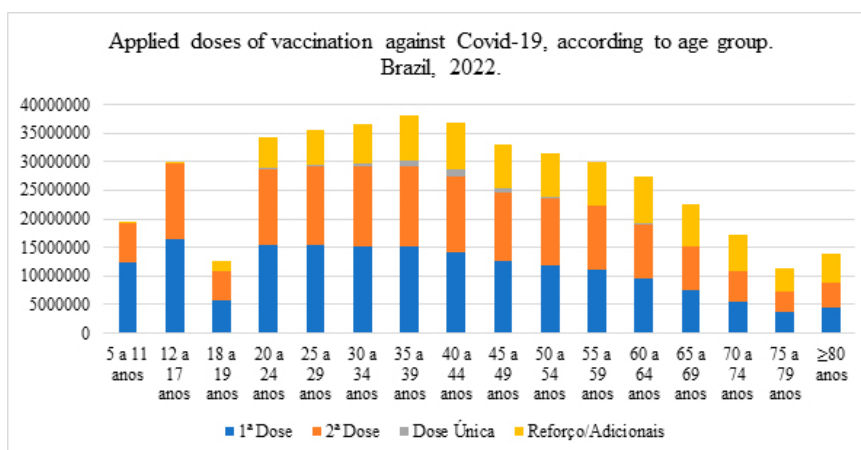
Source: Rede Nacional de Dados da Saúde - RNDS (National Health Data Network)

In absolute numbers by region in Brazil, the Southeast region leads the number of doses applied (353,197,267 doses), followed by the Northeast (192,296,099), South (113,722,011), Midwest (55,705,159), and North (52,705,159) (Table 2).

Table 2. Distribution of doses against COVID-19 applied, according to Brazilian regions. Brazil - 2022

Region	Total[1]	1ª Dose	2ª Dose	Single dose	Reinforcement/ Additional
Midwest	30.611.893	13.182.689	11.405.897	504.680	55.705.159
North East	106.492.852	45.962.340	38.956.371	884.536	192.296.099
North	28.080.286	13.267.875	10.769.536	295.478	52.413.175
Southeast	199.758.162	77.912.387	73.230.058	2.296.660	353.197.267

Source: Rede Nacional de Dados da Saúde - RNDS (National Health Data Network)
Note[1]: There are 17,598 notifications without region registration.

Discussion

Considering the morbidity and mortality that COVID-19 presents, the vaccines can be considered as one of the main tools to battle the disease, since it promotes countless benefits for public health.[7]

Even with vaccines available, the virus dissemination has not been totally controlled; however, it resulted in mortality reduction after the development of the vaccine, yet this phenomenon has been demonstrating the greatest challenge for global public health. Although vaccination has decreased the number of cases, the pandemic is still not restrained.[8]

In 2022, a study of 9,487 participants identified the main obstacles to immunizing the Latin American population against COVID-19. Among the findings, two obstacles were most prevalent: forgetting to get the vaccine and fear of the technology triggering intercurrences in the body. However, according to the survey, the experience of the pandemic set, illness, and/or death of loved ones made 12% of the members gather more positive about the importance of vaccination, and more than 80% were willing to be vaccinated against COVID-19.[9]

The Brazilian elderly population is approximately 30 million people, and they constitute a portion of the population that is included among risk groups due to vulnerability to illness and death from SARS-CoV-2 infection.[10]

By the end of 2021, people over the age of 18 could go to health services for their first booster dose. In the same period, 93% of the elderly already had the complete vaccination schedule against COVID-19, since they were the first group to receive the third dose, as they belong to a priority group. Thus, the reason for the increase in vaccination in adults between 20-59 years of age and the reduction among those over 60 years of age in 2022 became evident.[10]

It is known that sex/gender analysis can provide important evidence on the biological mechanisms that influence disease pathways in the human body, as well as the identification of social/structural factors that influence risk and vulnerability. In this sense, sex and gender play important and often overlooked roles in determining the differential health impacts of COVID-19 on people and populations.[11]

According to a study on prevalence and factors associated with vaccine hesitancy against COVID-19 in a northeastern Brazilian state, the factors that interfere with vaccine hesitancy depend on gender, age, and religion.[12] Based on *The Covid-19 Sex-Disaggregated Data* Tracker project, organized by the Global Health 50/50 initiative, which seeks gender equality in health, in countries such as the United States, Brazil, France, and New Zealand, women are getting more vaccinated against COVID-19.[13]

As attitudes towards vaccines can be multifactorial, evidence-based strategies must be implemented to improve acceptance of the COVID-19 vaccine. Thus, in order to achieve immunity in the global population, a two-pronged approach is needed: combating vaccine hesitancy and promoting equal access to vaccines, regardless of sex and/or gender and social factors.[11,13]

An explanatory factor for the greater adherence of women to vaccines may be due to the patterns of search in health services. Women use health services relatively more than men do. In addition, men have a greater tolerance for pain and discomfort, and the refusal to seek medical services is seen as a "positive attribute of masculinity". Such male behavior corroborates the increased risk of serious illness and death from COVID-19.[13-14]

On the other hand, there is a study that states that pregnant women are more likely to refuse COVID-19 vaccination than non-pregnant and lactating women. Among pregnant interviewees, specific reasons for not accepting the vaccine are related to concerns about possible harm to them or the fetus, such as infertility. Among those who accepted vaccination, the influences that favored vaccination included efficacy and safety data from available publications.[15]

The Southeast Region has among its Federative Units (FU) the most populous in Brazil, São Paulo (vaccination champion), Minas Gerais, and Rio de Janeiro. In addition, the vaccination rates against COVID-19 in the aforementioned states make the number of vaccinated Brazilians increase the country's position in an international ranking and lead the national one. With regard to the North, there are states with the lowest population, and many cities are difficult to access, placing the region in last place among the others in the state when comparing the number of doses applied.[8]

However, it is clear that the challenge of carrying out immunization campaigns was already present in Brazil and, above all, in other countries with an already consolidated health system. Thus, one can cite the difficulty in establishing population figures, due to the impasses generated by the inter-census estimates carried out by the Instituto Brasileiro de Geografia e Estatística - IBGE (Brazilian Institute of Geography and Statistics). In addition, difficult access to remote areas hinders the adoption of active search, leading to a potential lack of assistance. Thus, some municipalities will effectively achieve the results desired by the campaign, while others will present potential barriers to access.[16] By overcoming these limitations, it is expected to effectively achieve vaccination coverage in the national territory.

This study had some strengths. First, because it is a study with a national sample, in which the data presented are the results of notifications from state health departments. Second, the sample included participants from all regions of Brazil, providing generalizable results that represent the Brazilian population. However, a limitation of this study was the existence of underreporting and delays in vaccination records, which may cause an underestimated analysis.

However, it is necessary to continue stimulating population adherence to vaccination, highlighting the importance of effectiveness, and stabilizing concern about side effects, as these facts have been obstacles that discourage vaccination, in addition to generating disbelief in government actions and distrust concerning the pharmaceutical industry.

Conclusion

In May 2022, through data obtained from the Vacinômetro-SUS portal, the status of COVID-19 doses in the national territory was elucidated. The data collected identified the prevalence of vaccine applications in females, in young adults between 20 and 59 years of age, and a lower number of vaccinations in the elderly population in May 2022.

Considering the evidence provided by geographical regions, the southeast leads the number, presenting

a greater amount of administered doses against COVID-19. Analyzing the number by federative units, the state of São Paulo precedes the others in the matter. However, there is the shortcoming that the proportionality of the numbers between de regions was not considered, instigating research with more incisive parameters, aiming at the contemplation of robust studies for better identification and comprehension of the public health needs.

The mass vaccination process promotes changes in the patterns of hospitalizations and deaths from COVID-19, reflecting the decrease in these occurrences and positively impacting the public health system. However, the distribution of doses applied in all Brazilian states is heterogeneous. It is important to recognize that the expansion of vaccination, especially prioritizing regions with low coverage and booster doses in more vulnerable population groups, can further reduce the impacts of the pandemic in the country. Even in the face of these facts, the study proved that Brazil obtained a satisfactory result of the vaccine evolution, considering the number of doses applied against COVID-19 throughout the national territory.

Authors' contributions

Rodrigues Júnior NS, Moreno SM, Machado MGO, Ibiapina ARS, and Costa Filho AAI participated in the conception and design of the manuscript, analysis, and interpretation of data, writing and/or critical review of the manuscript, and approval of the final version to be published.

Conflict of interests

No financial, legal or political conflicts involving third parties (government, companies and private foundations, etc.) were declared for any aspect of the submitted work (including, but not limited to grants and funding, participation in an advisory board, study design, preparation manuscript, statistical analysis, etc.).

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