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ORIGINAL ARTICLE

Vaccination coverage in children in the state of Minas Gerais between 2018 and 2021: evaluation of the possible impact of COVID-19 on child immunization

Cobertura vacinal em crianças no estado de Minas Gerais entre 2018 e 2021: avaliação do possível impacto da COVID-19 na imunização infantil

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ABSTRACT

Introduction: Vaccination makes it possible to eradicate, eliminate or control immunopreventable diseases globally. The new coronavirus pandemic is known to have challenged health systems worldwide in the delivery of essential services, including immunization programs, because routine vaccination and mass vaccination campaigns could contribute to the spread of COVID-19. The World Health Organization (WHO) estimates that at least 80 million children will be susceptible to immunopreventable diseases because of failing vaccination coverage during the pandemic. **Objectives:** The present study aimed to evaluate the possible drop in childhood vaccination coverage in the state of Minas Gerais during the pandemic of COVID-19. **Methods:** This is a descriptive, cross-sectional type study, based on the collection of secondary data available in DATASUS. **Results:** The pandemic caused by COVID-19 and its consequences influenced negatively the collective immunization plan for children in the state of Minas Gerais, evidencing a drop in vaccination coverage. Strategies aimed at immunization actions and updating children's vaccination schedules are essential in order to avoid the recrudescence of already eradicated or controlled diseases.

Keywords: COVID-19; Vaccination coverage; Child health.

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RESUMO

Introdução: A vacinação permite erradicar, eliminar ou controlar doenças imunopreveníveis globalmente. Sabe-se que a pandemia do novo coronavírus desafiou os sistemas de saúde do mundo todo na prestação de serviços essenciais, incluindo os programas de imunização, pois a vacinação de rotina e as campanhas de vacinação em massa poderiam contribuir para a disseminação da COVID-19. A Organização Mundial da Saúde (OMS) estima que pelo menos 80 milhões de crianças estarão suscetíveis a doenças imunopreveníveis por conta da queda das coberturas vacinais durante a pandemia. **Objetivo:** O presente estudo teve o objetivo de avaliar a possível queda da cobertura vacinal infantil no estado de Minas Gerais durante a pandemia de COVID-19. **Métodos:** Trata-se de um estudo descritivo, do tipo transversal, baseado na coleta de dados secundários disponíveis no DATASUS. **Resultados:** A pandemia causada pela COVID-19 e suas consequências influenciaram negativamente o plano de imunização coletiva de crianças no estado de Minas Gerais, evidenciando queda na cobertura vacinal. Estratégias voltadas a ações de imunização e atualização do calendário vacinal das crianças são imprescindíveis, a fim de se evitar o recrudescimento de doenças já erradicadas ou controladas.

Palavras-chave: COVID-19; Cobertura vacinal; Saúde da criança.

Introduction

Brazil is among the countries with the most advanced vaccination programs in public health. The National Immunization Program (PNI) was instituted in 1974, as an instrument for the implementation and organization of the vaccination calendar in the country, or that made it possible to eradicate and control immunopreventable diseases in the country, reflecting a well-succeeded immunization program[1]. In the current Brazilian health policy, vaccination is a priority action of Primary Health Care (APS), specifically in the Family Health Strategy (ESF), and has a great impact on the general health conditions of the population[2].

Brazil develops its actions in a shared way with states and municipalities, through more than 35 thousand vaccine rooms in accordance with the Information System of Basic Care, of the Ministry of Health. The organization of the national calendar, the availability of two immunobiologicals in the public health network and the goal of vaccinating all children in the same year of birth are essential aspects for the good vaccination coverage rates observed in our country[1].

Computerized immunization records are useful for monitoring vaccination coverage, including identification and search for defects and verification of vaccination at the recommended dose. Concomitantly with high vaccine coverage, a fundamental aspect to maximize the protection of individuals and populations is the application of vaccines at the recommended date. The ideal dose recommendations for vaccine applications, minimum and maximum doses, two intervals between the doses in the case of vaccines with a multidose scheme, and their monitoring is important to establish the risk of disease in the population, particularly for the diseases in which life is related to gravity or complications[3].

Vaccination represents a very impacting factor ((if not the most impacting one) in child health conditions. The current vaccination schedule offers 18 vaccinations for children, conferring protection against debilitating etiological agents and more than twenty diseases. The vaccines recommended on the calendar are: BCG, Hepatitis B, DTP+Hib+HB (Penta), pneumococcal 10 valent, human rotavirus, meningococcal conjugate, yellow fever, polio 1 and 3, SCRV (measles/mumps/rubella/varicella), hepatitis A, diphtheria/tetanus (Td), human papillomavirus (HPV), 23-valent pneumococcal, and influenza[4,5].

The Ministry of Health continually reinforces that immunization is extremely important to prevent deaths and sequels caused by immunopreventable diseases such as, blindness, paralysis, neurological problems[4,5].

Since the 1990s, infant vaccination coverage has been above 95%, which indicates the population's increase in vaccination. However, as of 2016, Brazilian vaccination coverage has shown a tendency to remain in a decline of about 10 to 20 percentage points, heading up, as a consequence, to a recrudescence of transmittable diseases

that are then under control, such as measles, that had been considered eradicated in 2016. Such a situation was unexpected and was accompanied by an increase in infant and maternal mortality, what is worrying and unacceptable, since it represents an avoidable cause of death[6].

At the same time that the isolation and the limitation of the circulation of people reduced the transmission, not only of SARS-CoV-2, but of other pathogens, the non-appearance of children to the health units for updating the vaccination calendar could impact the vaccination coverage and place everyone's health at risk, especially in the face of the epidemiological situation of measles, yellow fever and whooping cough currently experienced. In this context, the Brazilian Society of Pediatrics together with the Brazilian Society of Immunization issued a non-intuitive scientific document to guide and clarify the society as a whole, about the extreme importance of vaccination in time and about the adequate doses in this pandemic period. According to the *Sociedade Brasileira de Pediatria* (SBP) and *Sociedade Brasileira de Imunizações* (SBIm), the supply of vaccines must be maintained regularly and sustained by the PNI, and the population must be encouraged to keep the vaccination calendar up to date, trying to visit the health unit closest to their residences and in the less busy hours. Also, the schedule should be optimized, with the application of the greatest number of vaccines possible in the same visit, as long as the minimum interval between the doses is respected, in order to reduce the number of visits to health units[7].

Before the post, the objective of this work was to analyze the childhood vaccination coverage in the state of Minas Gerais in the period between 2018 and 2021, evaluating the possible impact of the COVID-19 pandemic on immunization rates.

Methods

This is a descriptive, cross-sectional study, based on the collection of secondary data on vaccination coverage of children between 0 and 12 years of age in the state of Minas Gerais in the period between 2018 and 2021.

For data the collection, the Immunization Program Assessment System (SAPI) was used, generated by the PNI General Coordination and made freely available by the Department of Informatics of SUS (DATASUS). This system registers, by age group, the doses of immunobiologicals applied and calculates the vaccination coverage by basic unit, municipality, regional of the State Department of Health, state and country, and Pprovides information on routine and campaigns, abandonment rate and sending immunization bulletins. The calculation formula for the coverage is given by the number of doses applied to the indicated dose (1st, 2nd, 3rd dose or single dose, according to cow) divided by the target population, multiplied by 100[5].

This way, it is possible to extract from the system the variables available for the tabulation related to the vaccination situation of children from 0 to 12 years of age in the state of Minas Gerais in the period between 2016 and 2021, including vaccination coverage, dropout rate and doses applied, accordingly to the type of immunobiological age group studied and regions of the state. Minas Gerais has an area of 588,384km^2, occupies 6.9% of the Brazilian territory and 63.5% of the Southeast region. It is the state with the largest number of municipalities in the Country, 853, corresponding to 15.5% of the total.

The data obtained were studied, initially, by means of descriptive analysis, considering these variables of interest. Subsequently, the data are organized in a plan for statistical analysis, with calculation of average and standard deviation for quantitative variables and proportion of cases for qualitative variables.

Results

Figure 1 below, created using the GraphPad Prism software, represents the comparison of the vaccination coverage during the last four years, with the data for 2021 referring to the first six months of the year. It is inferred that child vaccination coverage in 2020 was significantly lower, mean 85.07%. Comparing the years between 2018 and 2020 and between 2019 and 2020, according to Table 1, in both cases the differences were significant, with p-value of 0.0001 and 0.0215, respectively.

Based on two indices of childhood vaccination coverage from the state of Minas Gerais obtained in the year 2020, it was also possible to build a thematic map of the stratified spatial distribution in four classes, using the quantis method (Figure 2). In this type of map, it is possible to identify clusters of regions with similar study indices. It was observed that these agglomerates in the northern extension of Minas Gerais, characterizing low-low regions, that is, in these regions, represented by blue color, had low vaccination coverage in the year 2020, showing municipalities with low vaccination coverage surrounded by other municipalities that also present low coverage. On the other hand, the red agglomerates indicate municipalities with high vaccination coverage surrounded by municipalities also with high indices, what it is perceived on the map to not to occur in a relevant way. It is also noted that despite the existence

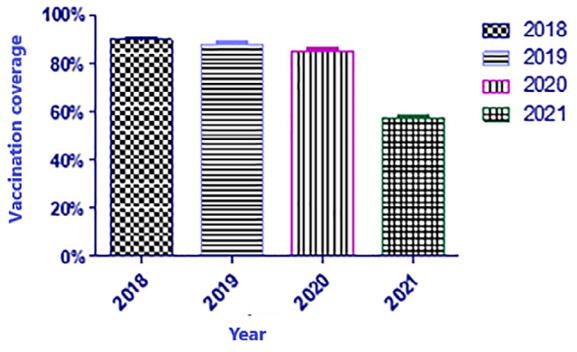


Figure 1. Vaccinal coverage between 2018 and 2021 in Minas Gerais.

Table 1. Comparison of vaccination coverage.

Year	N. Municipalities	Average Vaccinal Coverage	Standard deviation	Median	*p* (value) Wilcoxon	r s (Spearman)
2018	**853**	89.8	17.74	88.34	< 0.0001	0.2804 ***
2019	**853**	87.86	19.15	85.44	0.0215	0.5783 ***
2020	**853**	85.07	22.92	84.99	-	-
2021*		57.36	19.4	58.47	-	-

Source: Elaborated by author.

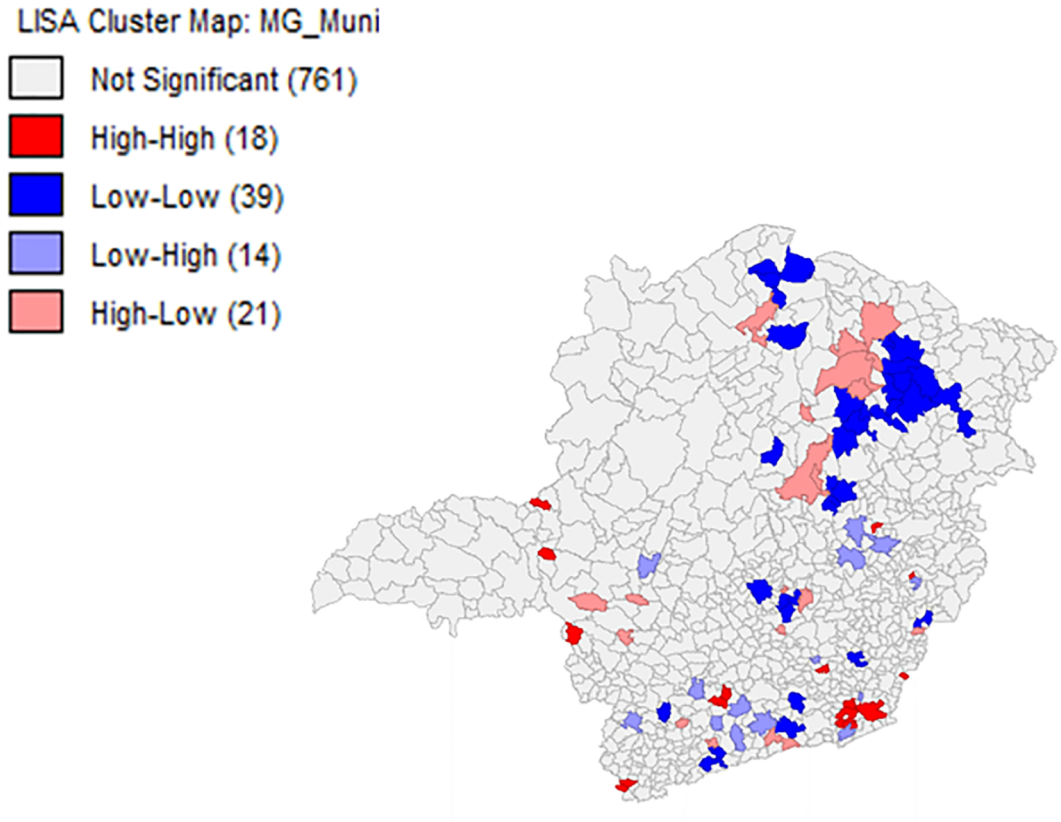


Figure 2. Thematic Map: Spatial distribution of vaccination coverage in Minas Gerais. Source: Elaborated by author.

of agglomerates with low vaccination coverage, there are some nearby regions that have high coverage, forming agglomerates of corrosion and demonstrating a certain heterogeneity of coverage at the state level.

As for the vaccination coverage according to immunobiologicals, it is apparent that, in general, all the vaccines present significant falls in vaccination coverage in 2020, when compared to previous years (Figure 3). As for the vaccines applied to the newborn, BCG and hepatitis B, there are about 19% and 18%, respectively. The measles immunoprevention rate, which has already represented a threat to public health due to the resurgence of outbreaks since 2016, now represents 5% in the first dose and 10% in the second dose.

Finally, Figure 4, the following graph shows the relationship between the lethality of COVID-19 and the number of cases per 100,000 inhabitants in a certain municipality and the same child vaccination coverage, in the year of 2020. Through Spearman's correlation, it is verified that there is not significant relationship between the number of cases or lethality of the coronavirus pandemic and the child immunization rate in two municipalities. The result obtained, practically horizontal, demonstrates that the local incidence of COVID cases is independent of the global impact of the pandemic or the state's vaccination coverage.

Discussion

This fact is essential for the growth and healthy development of the child population to obtain high and homogeneous vaccination coverage in a given location, which reflects on the maintenance of health and the quality of life for society as a whole.

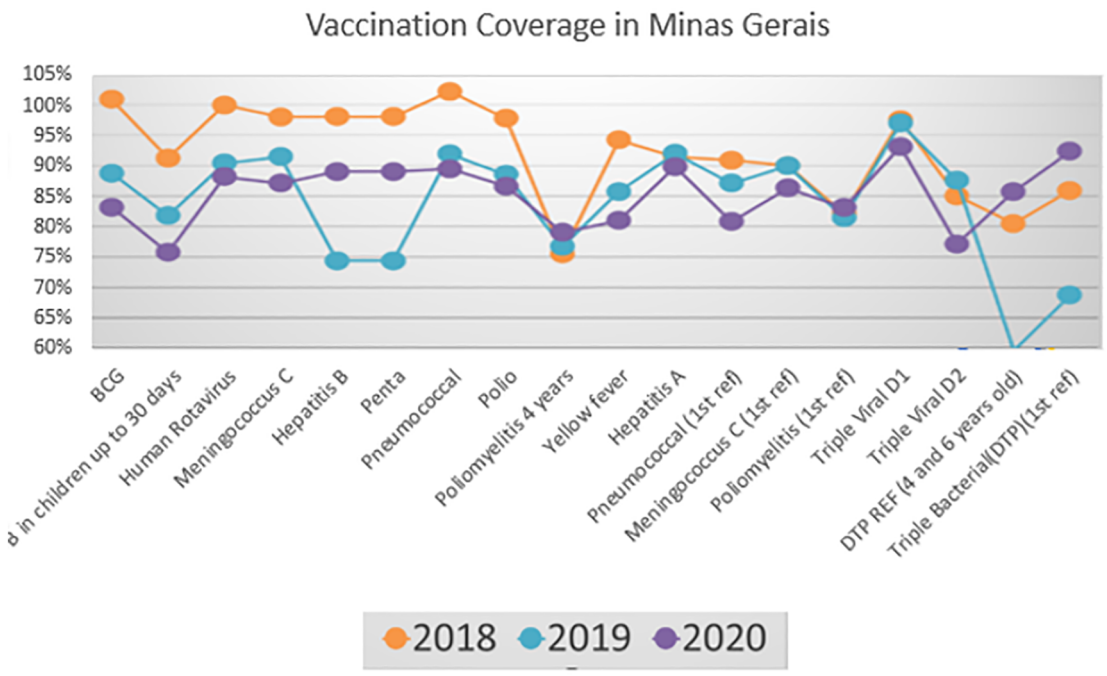


Figure 3. Immunobiological vaccination coverage. Source: Elaborated by author.

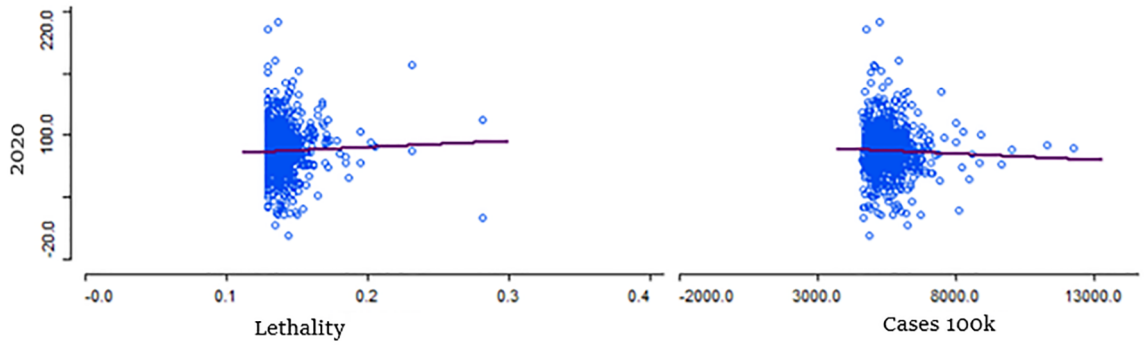


Figure 4. Vaccination coverage and COVID in 2020. Source: Elaborated by author.

Despite the scarcity of studies related to the impact of the pandemic on immunization actions, a risk-benefit study in African countries showed that deaths avoided by routine vaccination exceeded the risk of death from COVID-19 associated with appearance without health care for the vaccination, evidencing the need for efforts to increase the vaccination coverage at this time. A second study in the United States reports that child vaccination coverage remains behind, that is, behind in all age groups analyzed when compared with the historical series of previous years[8,9].

The results obtained from this study will show that, in the state of Minas Gerais, there is still significant child vaccination coverage in the pandemic period experienced. With a decrease in the number of vaccinations corresponding to the Brazilian vaccination calendar, there are obviously negative consequences for public health, since such a situation enables the emergence of new outbreaks of diseases previously controlled or eradicated.

The spatial heterogeneity of the vaccination coverage in the different municipalities of Minas Gerais identified in this study provokes a reflection on the way of confronting the pandemic in each locality. It is not known if this greater variation in vaccination coverage in the year 2020 was due to true negligence in routine vaccination or the non-updating of the doses applied in the system in some municipalities. When this considerable variability in immunizations is verified, it is clear that strategic planning is needed in accordance with the characteristics of each locality and expanded humanization capacities to meet the demands of the population and avoid lost opportunities for vaccination. In addition, the fact that there is no proportional correlation between the number of COVID-19 cases/fatality and the

remaining vaccination coverage, reinforces that the effort to increase the immunization rate and reduce the vaccination delay in children must be undertaken jointly, at municipal, state, federal and global levels.

Immunoprevention actions currently represent the lowest percentage in relation to avoidable causes of infant deaths. It is inferred that the expansion of the Family Health Strategy together with the National Immunization Program is essential to protect children since birth against preventable diseases, allowing them to stop being also – definitively – the cause of infant death[10].

Everyone's health is at risk, especially in the face of the epidemiological situation of measles, yellow fever and whooping cough. As of May 2020, 19 Brazilian states registered active circulation of the measles virus. In the country, the age group from 20 to 29 years old has the highest number of confirmed cases, however, the highest rate of incidence is among those under 5 years of age (13.1/100,000 inhabitants), especially not in the first year of life[11].

There are several factors for the remains of the vaccine coverage. Among them we can list the main ones such as the lack of perceptions of the risk of immunopreventable diseases for the population, changes in the data collection systems of the PNI, due to the increase in the number of vaccines available and updates to the recommendations by the Ministry of Health. The lack of training and of trained professionals to work in vaccine rooms, the opening hours of the vaccination posts, the momentary shortages of some immunobiologicals, the rise of the anti-vaccine movement and the fake news also contributed to the lack of coverage population vaccination[12].

Likewise, the effective fulfillment of the child's vaccination calendar depends on several factors, from the availability of services and health units structured according to factors related to knowledge about immunizations and socioeconomic characteristics of the family of upbringing. In this regard, from the careful evaluation of the coverage child vaccination in the state of Minas Gerais, considering the trend found in these indices in the study period and its determinants, and here, it is worth noting the importance of assessing the impact of the COVID-19 pandemic; it is possible to trace measures at different levels of management that allow, primarily, a mobilization of both health professionals, as well as political authorities and the population itself in search of guaranteeing the success of the immunization program and consequently the protection of the health of children. It becomes clear the need to implement measures aimed at circumventing such a negative impact of the pandemic on the Brazilian Immunization Program, including, for example, strengthening Health Strategies, health education in care units and homes for the users, health care programs home vaccination and administration of combined doses, active search for unvaccinated children and integration of other health agents with immunization.

In this scenario, it should be noted that vaccination is a priority in public health and must be maintained, whenever possible, with the adoption of strategies adapted to local realities. Likewise, it is evident the importance that these strategies can represent to re-establish the levels of adequate vaccination coverage for the entire child population, mainly for the most vulnerable.

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Authors' Contribution

We describe contributions to the papers using the taxanomy (CRediT) provide above. Conceptualization, Investigation, Methodology, Visualization & Writing – review & editing: Ana Flávia da Silva. Project administration, Supervision & Writing – original draft: Ana Flávia da Silva. Validation & Software: José de Paula Silva Resources & Funding acquisition: Author DD. Data curation & Formal Analysis: José de Paula Silva.

Both authors contributed to the preparation, revision and submission of the manuscript.

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