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VACCINE COVERAGE IN THE FIRST HALF OF LIFE: AN ANALYSIS OF RATES BETWEEN THE YEARS OF 2011 TO 2021

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Abstract: Objective: To analyze the available data, over the ten-year period, from 2011 to 2021, comparing the rates of improvement or worsening in the immunization of infants up to six months of age, the vaccines analyzed are those recommended in the PNI for this range age. **Methods:** Time series study with secondary analysis of data on BCG, Human Rotavirus, Hepatitis B, Meningococcus C, Penta, VIP and Pneumococcal vaccines from 2011 to 2021. The data were made available on the DATASUS website, which was sourced from National Immunization Program Information System. As an inclusion criterion, data from all children who were vaccinated up to six months of age with any of the vaccines analyzed were selected. **Results:** Among the vaccines offered in the PNI, it is possible to observe a considerable drop in adherence of all, between the years 2011 to 2021, in the State of Minas Gerais (MG), the VIP vaccine had a reduction of 30.93% in Meningococcus C, 30.88%, BCG, 28.31%, Pentavalent, 25.87%, Pneumococcal 10, 24.34%, Rotavirus, 20.39% and Hepatitis B, 18.65%. Vaccination must reach a level of at least 90% and the average coverage, at the end of these 10 years analyzed, was on average 75%. **Conclusion:** A considerable reduction in adherence to immunization of infants up to 6 months was observed, being on average 15% lower than recommended in MG.
Keywords: Vaccination; Immunization; PNI; Infants; SUS (Unified Health System)

INTRODUCTION

In September 1973, by order of the Ministry of Health, the National Immunization Program (PNI) was created, which aims to provide access to free immunization for all Brazilians and values social inclusion and eradication of endemic diseases. It is today considered one of the largest programs in the world, with 45 immunobiologicals available

for individuals of the most different age groups, demonstrating its concern with the safety and availability of products for the entire population (BRASIL, 2003).

Brazil is among the rare nations that make this prevention universally available and represents a model to be followed, however, it is possible to notice a drop-in vaccination levels over the years. One of the causes of this change is the success achieved by the program, since diseases at the beginning of the movement visibly impacted the population, while nowadays, due to the absence of these diseases, part of the population believes that the diseases are not capable of returning., disregarding the need to continue getting vaccinated (NATIONAL COUNCIL OF HEALTH SECRETARIES (CONAS), 2017).

For a vaccine to be able to protect and prevent all children, a minimum vaccination coverage of 90% is required (WESTIN, 2022). Thus, in 2021, in Minas Gerais, the lowest levels of immunization were found, according to an analysis of the last 10 years, which also states that most of the vaccines scheduled in the first 6 months of life have an average range of 75% population.

Considering the historical context, the first vaccination campaign that took place in Brazil was led by the doctor Oswaldo Cruz and its main objective was to eradicate smallpox, however, with its obligation and lack of knowledge among the population at the beginning of the 20th century, generated the episode known as the Vaccine Revolt, taking place in the city of Rio de Janeiro as its stage. This event became known as a popular riot and caused Oswaldo to be the target of several criticisms and cartoons at the time. (PORTO, M. Y, 2003)

Thus, around 118 years have passed, but Brazil still faces remnants of the aforementioned revolt, as the act of getting vaccinated is still associated with different beliefs, conceptions, policies and cultures, often making the desired vaccination coverage difficult. Therefore, we see the importance of health management and mass communication, aiming to transmit coherent information, highlighting the high rates of effectiveness in the use of these immunizers. (LACHOWICZ *et al,* 2021)

According to PNI, there are 7 vaccines that require vaccination coverage in the first 6 months of life, they are: BCG, Hepatitis B, Pentavalent, VIP, Human Rotavirus, Pneumococcal 10, Meningococcal C. According to the comparison of vaccination coverage from 2011 to 2021, in general, a significant drop in vaccination levels in the first 6 months of life, starting in 2019, in the state of Minas Gerais, is noticeable.

Another factor that influenced, according to Westin (2022), was the pandemic experienced worldwide by COVID-19, which advocated social distancing and, a large part of the population, preferred not to leave their homes during the beginning of this emergency. Therefore, many of those responsible preferred not to take the children to health units to avoid possible contagion among the little ones.

Furthermore, awareness and vaccination programs, during this catastrophic period, were left aside by both the media and health teams, who focused only on ways to prevent and control the pandemic. Therefore, after the various fake news released by the media and disseminated by civil society, it also made some of them believe in mystical ideologies and avoid vaccination due to distrust of artificial immunobiologicals (WESTIN, 2022).

In view of the current context, vaccination, especially of infants and young children, is considered a noble and extremely important act in the fight against infectious diseases, but it is known that even with the availability of vaccines, many children still die. diseases

that could be prevented through vaccination. (SOUZA, C de J. *et al,* 2012) Therefore, the importance of understanding by parents and guardians that the complete vaccination schedule is an act of responsibility and love is evident.

Thus, the present study aims to highlight data on the vaccination of infants up to 6 months of age with the vaccines recommended in the PNI for this age group over a period of ten years, between 2011 and 2021, comparing rates of improvement or worsening in the scope of immunization.

METHODOLOGY

This is a time series study with secondary data analysis of the BCG, Human Rotavirus, Hepatitis B, Meningococcus C, Penta, VIP and Pneumococcal vaccines, including the period from 2011 to 2021, based on records and information available in the DATASUS website (Informatics Department of the Unified Health System), which had as its source the Information System of the National Immunization Program.

Bar graphs of all the vaccines mentioned above were analyzed on the DATASUS website, using the age variable, so that a comparison could be made of vaccination coverage from 2011 to 2021, with the exception of the Hepatitis B vaccine, for which no data were found. from 2011 to 2013 and the Penta vaccine, which was only introduced into the National Immunization Plan in 2012. In addition, histograms were also used with vaccination information, in order to facilitate visualization of data distribution.

As an inclusion criterion, data from children aged 0 to 6 months in the state of Minas Gerais in the period from 2011 to 2021 were selected in this study, who were vaccinated with the following vaccines: BCG, Human Rotavirus, Hepatitis B, Meningococcus C, Penta, VIP and Pneumococcal. Furthermore, only children counted by the DATASUS system were included.

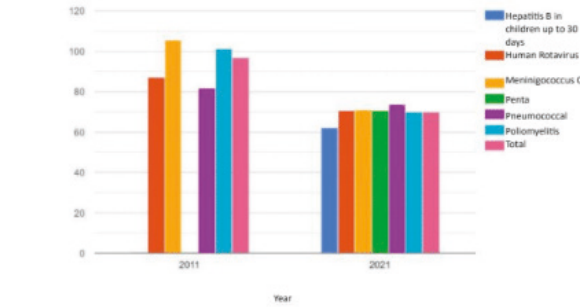
As exclusion criteria, data from children available in DATASUS outside the age range of 0 to 6 months of age and data from those living in other states in Brazil were excluded, despite also receiving the vaccines in question: BCG, Human Rotavirus, Hepatitis B, Meningococcus C, Penta, VIP and Pneumococcal.

The study in question, as it is a review of secondary data, does not need to be approved by the Ethics Committee. The research relied on the manipulation of data obtained through the DATASUS digital platform.

RESULTS AND DISCUSSION

Vaccination coverage values for 2011 and 2021, in the state of Minas Gerais, are shown in Figure 1. The highest average coverage was found in 2011 (101.92%), and the lowest in 2021 (74.81%). Among the vaccines analyzed, hepatitis B in children up to 30 days of age and penta do not contain data from 2011.

According to Oliveira, *et al.* (2021), the coverage target recommended by the PNI for all vaccines in the pediatric age group is 95% or 90%, depending on the vaccine, for effective protection against these antigens to occur. The lowest levels, in these 10 years, that were analyzed, in which most of the vaccines planned in the first 6 months of life have an average reach of 75% of the population (WESTIN, 2022), a fact that could trigger new epidemiological outbreaks in the Minas Gerais region.



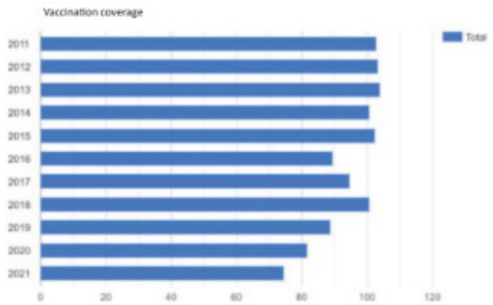
Year	BCG	Hepatitis B in children up to 30 days	Human Rotavirus	Meningococcus C	Penta	Pneumococcal	Poliomyelitis	Total
Total	89.43	62,21	78,83	88,40	70,47	77,60	85,74	81,07
2011	107,94	-	87,06	105,66	-	81,65	101,33	96,73
2021	70,69	62,21	70,52	70,96	70,47	73,52	69,98	69,77

Figure 1: Vaccination coverage in 2011 and 2021, in the state of Minas Gerais

Source: Information System of the National Immunization Program (SI-PNI/CGPNI/DEIDT/SVS/MS)

The BCG vaccine, which protects against the most serious forms of tuberculosis, seen in Figures 2 and 3, had a variation in vaccination coverage from 104.06 to 74.57%, with the highest and lowest percentages being recorded in 2013. and 2021, respectively, with a difference of 29.49 percentage points. Thus, it had maintained ideal coverage (90%) until 2015, with an average of 102.7%. In 2016 it showed a reduction falling to 89.41%, in the two subsequent years it showed an increase, with values above 90%, however from 2018 onwards it decreased again, thus obtaining the lowest coverage in 2021. Thus presenting a reduction between 2011 (102.88%) and 2021 (74.57%) of 27.51%.

In view of this, it is understood that reducing this vaccination rate to less than 95% coverage, according to Rolim, *et al* (2022), could cause public health problems, causing the possibility of new epidemics emerging in the population, since in In unvaccinated children, the immune system may not be prepared to fight such an infection and, consequently, complications will occur.



Year	BCG	Total
Total	94,82	94,82
2011	102,88	102,88
2012	103,34	103,34
2013	104,06	104,06
2014	100,85	100,85
2015	102,41	102,41
2016	89,41	89,41
2017	94,81	94,81
2018	100,85	100,85
2019	88,76	88,76
2020	81,65	81,65
2021	74,57	74,57

Figure 2: Vaccination coverage from 2011 to 2021 of the BCG vaccine, in Minas Gerais

Source: Information System of the National Immunization Program (SI-PNI/CGPNI/DEIDT/SVS/MS)

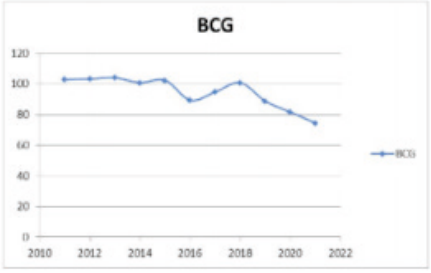


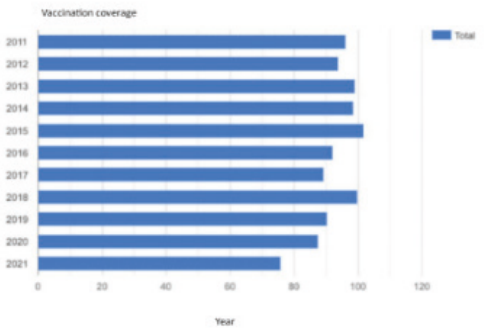
Figure 3: Scatter diagram of vaccination coverage of the BCG vaccine, in the state of Minas Gerais, between the years 2011 and 2021

Source: Own authorship.

The Human Rotavirus vaccine, which prevents acute diarrhea in children, presented in Figures 4 and 5, had a variation in vaccination coverage from 101.89 to 75.83%, recorded in the years 2015 and 2021, respectively, showing a difference of 26.06 percentage points. Its coverage was ideal (95%) in the years 2011, 2013, 2014, 2015 and 2018. The highest coverage found was in 2015, in the following two years it presented lower values and in

2018 it obtained an increase, however it was observed a continuous drop in the coming years, reaching the lowest coverage in 2021, thus obtaining a reduction between the years 2011 (96.22%) to 2021 (75.83%) of 21.19%.

According to Rolim, *et al* (2022), Alagoas failed to achieve the goals stipulated by the PNI for vaccination, especially during the lockdown period, parents prefer not to take their children to health units to avoid contagion from these young children. Therefore, it is observed that the vaccination coverage targets of 90% was not reached in several places in Brazil, and not just in the state of Minas Gerais (WESTIN, 2022).



Year	Human Rotavirus	Total
Total	93,13	93,13
2011	96,22	96,22
2012	93,79	93,79
2013	99,12	99,12
2014	98,57	98,57
2015	101,89	101,89
2016	92,20	92,20
2017	89,21	89,21
2018	99,96	99,96
2019	90,40	90,40
2020	87,56	87,56
2021	75,83	75,83

Figure 4: Vaccination coverage from 2011 to 2021 of the Human Rotavirus vaccine, in Minas Gerais

Source: Information System of the National Immunization Program (SI-PNI/CGPNI/DEIDT/SVS/MS)

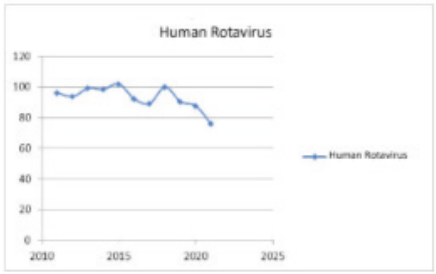
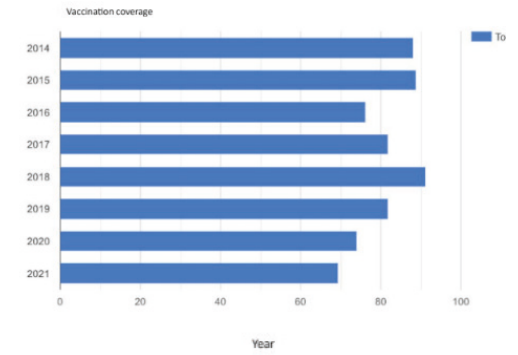


Figure 5: Dispersion diagram of vaccination coverage of the Human Rotavirus vaccine, in the state of Minas Gerais, between the years 2011 and 2021

Source: Own Authorship

Figures 6 and 7 show vaccination coverage against hepatitis B in children up to 30 days of age, the range of coverage was from 91.22% to 69.38%, in the years 2018 and 2021, respectively, thus, there was a difference of 21.84 percentage points. Data for the years 2011 to 2013 were not found. Like the vaccines already presented, there was also a decrease in coverage in the years 2016 and 2017, with an average of 79.01%. The highest value found was in 2018, since then it has gradually decreased. The reduction shown between 2014 (88.03%) and 2021 (69.38%) was 21.18%

Given these data on decreased vaccination and according to Durans, *et al.* (2021), as a consequence of this significant drop, there was a significant increase in the number of hospitalizations in Maranhão. Therefore, it is understood that the relationship between the reduction in vaccination coverage and the increase in diseases is important at a national level, which could cause harm to the population, as could be a possible situation in Minas Gerais.



Year	Hepatitis B in children up to 30 days	Total
Total	72,36	72,36
2014	88,03	88,03
2015	88,92	88,92
2016	76,13	76,13
2017	81,89	81,89
2018	91,22	91,22
2019	81,77	81,77
2020	74,07	74,07
2021	69,38	69,38

Figure 6: Vaccination coverage from 2014 to 2021 of the Hepatitis B vaccine in children up to 30 days old, in Minas Gerais

Source: Information System of the National Immunization Program (SI-PNI/CGPNI/DEIDT/SVS/MS)

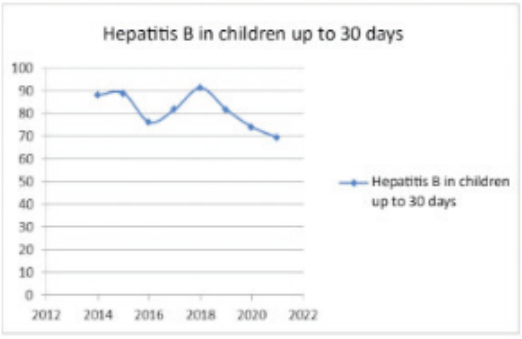


Figure 7: Scatter diagram of vaccination coverage of the Hepatitis B vaccine in children up to 30 days old, in the state of Minas Gerais, between the years 2011 and 2021

Source: Own Authorship

Analyzing the meningococcus C vaccine in Figures 8 and 9, a range of 106.04% to 75.16% is observed, in the years 2011 and 2021, respectively, which presents a difference of 30.88 percentage points. Vaccination coverage considered ideal (95%) was recorded until 2015 and again in 2018, after which it showed a progressive decline, with the lowest rate in 2021. Thus, its reduction was 29.12% of coverage in 10 years.

Meningococcal disease, according to Hipólito, *et al.* (2022), involves several complications such as deafness, neurological deficit and mortality in severe cases, therefore, children who are vaccinated have greater protection against this pathology and its complications. Thus, it is understood that there is a failure in the state of Minas Gerais to not comply with the necessary vaccination coverage to eradicate the disease, since vaccination coverage is below 95%, which can affect child growth, since affects the child's neuropsychomotor development, such as hearing loss, cranial nerve palsies, hemiparesis or tetraparesis (NAMANI, *et al.*, 2013).

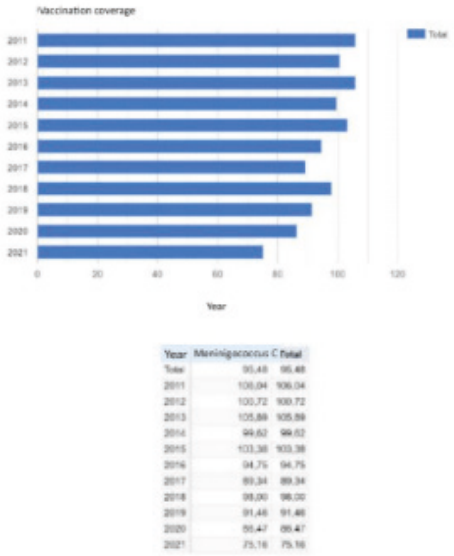


Figure 8: Vaccination coverage from 2011 to 2021 of the Meningococcus C vaccine, in Minas Gerais

Source: Information System of the National Immunization Program (SI-PNI/CGPNI/DEIDT/SVS/MS)

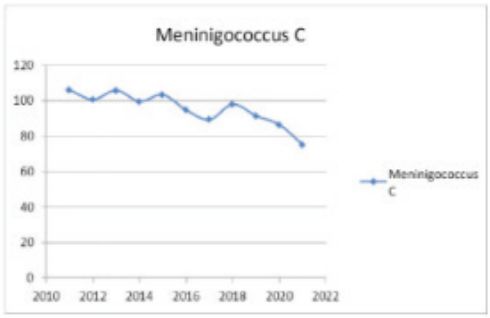
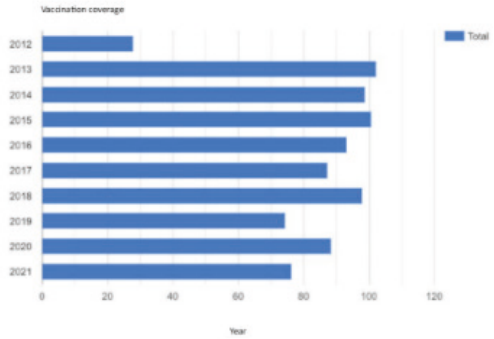


Figure 9: Scatter diagram of vaccination coverage of the Meningococcus C vaccine, in the state of Minas Gerais, between the years 2011 and 2021

Source: Own Authorship

The pentavalent vaccine was introduced into the National Immunization Plan in 2012, however, it achieved low vaccination coverage of 27.81% in the same year. However, from 2013 onwards, it began to have significant values. Thus, its vaccination range, observed in Figures 10 and 11, was from 102.21% to 74.36%, in the years 2013 and 2019, respectively, with a difference of 27.85 percentage points. In the years 2013 to 2015, coverage was above 95%, in 2016 and 2017 there was a decline in values, in 2018 there was a significant increase of 10.7 percentage points in 1 year, once again achieving ideal coverage. Despite this, since then it has shown a decrease in values, with lower percentages found in 2019 of 74.36% and in 2021 of 76.34%. Therefore, between 2013 and 2021 there was a 25.31% drop in vaccination coverage.

It is important to understand that the pentavalent vaccination coverage rate has been reducing, which increases the possibility of new outbreaks, thus increasing the number of reported deaths of children due to diseases such as Whooping Cough, which is one of the components of the penta vaccine (MANGIAVACCHI, *et al.*, 2022). Therefore, in Minas Gerais, the drop in the vaccination rate is relevant to possible complications for children's health.



Year	Penta	Total
Total	84,87	84,87
2012	27,81	27,81
2013	102,21	102,21
2014	98,75	98,75
2015	100,70	100,70
2016	93,25	93,25
2017	87,32	87,32
2018	98,05	98,05
2019	74,36	74,36
2020	88,33	88,33
2021	76,34	76,34

Figure 10: Vaccination coverage from 2012 to 2021 of the Penta vaccine, in Minas Gerais

Source: Information System of the National Immunization Program (SI-PNI/CGPNI/DEIDT/SVS/MS)

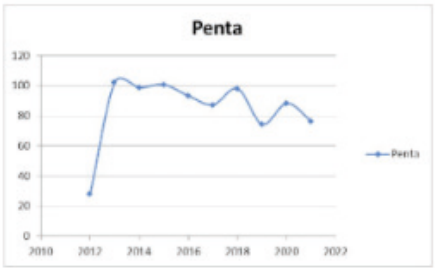


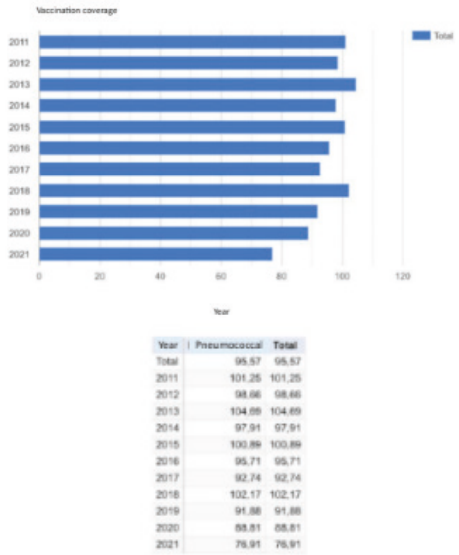
Figure 11: Dispersion diagram of vaccination coverage of the Penta vaccine, in the state of Minas Gerais, between the years 2011 and 2021

Source: Own Authorship

Below, in Figures 12 and 13, we have pneumococcal vaccine data from 2011 to 2021, the range presented was from 104.69% to 76.91%, in the years 2013 and 2021, respectively, with a difference of 27.78 percentage points. Ideal vaccination coverage was maintained between 2011 and 2016 and separately in 2018. A reduction was observed in 2016 and 2017, but it was from 2018 onwards that there was a gradual reduction,

with a drop-in coverage vaccination in the 10 years analyzed of 24.04%.

According to Hipólito, *et al.* (2022), pneumococcal vaccination managed to reduce the hospitalization rate in children under 1 year of age in Minas Gerais, in view of this, it is clear that there is a need to reach the vaccination coverage target of 95%, so that in the end it reduces complications and possible mortalities. caused by this pathology.



Year	Pneumococcal	Total
Total	95,57	95,57
2011	101,25	101,25
2012	98,66	98,66
2013	104,69	104,69
2014	97,91	97,91
2015	100,89	100,89
2016	95,71	95,71
2017	92,74	92,74
2018	102,17	102,17
2019	91,88	91,88
2020	88,81	88,81
2021	76,91	76,91

Figure 12: Vaccination coverage from 2011 to 2021 of the Pneumococcal vaccine, in Minas Gerais

Source: Information System of the National Immunization Program (SI-PNI/CGPNI/DEIDT/SVS/MS)

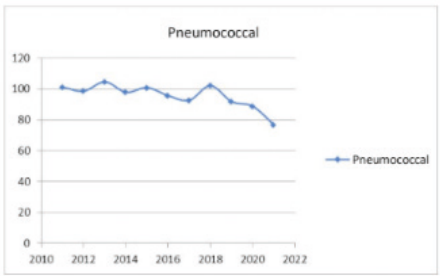
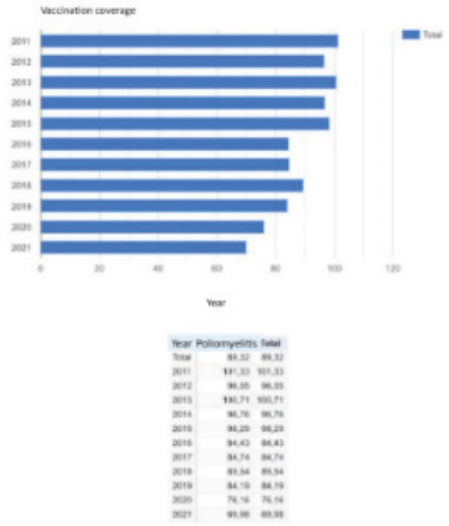


Figure 13: Scatter diagram of vaccination coverage of the Pneumococcal vaccine, in the state of Minas Gerais, between the years 2011 and 2021

Source: Own Authorship

Vaccination coverage for polio, shown in Figures 14 and 15, has a similar pattern to other vaccines, the highest range recorded was from 101.33% to 69.98%, in the years 2011 and 2021, respectively, obtaining a difference of 31.35 percentage points. Ideal coverage was maintained until 2015, where it registered 98.29%, after the same year it showed a progressive decline, with the exception of 2018, where there was a small increase, still below ideal. Thus, the drop reached its lowest rate in 2021, with a 30.93% reduction in vaccination coverage between 2011 and 2021.

Therefore, it is understood that the objective of vaccination against Poliomyelitis is to prevent the child from acquiring the virus and causing damage to the nervous system, which can cause paralysis in a few hours, however, it is noted that the numbers are decreasing, in that the minimum must be 95% coverage. Therefore, the population is at risk of having new outbreaks of this highly contagious antigen and affecting children (FUNDAÇÃO OSWALDO CRUZ, 2018).



Year	Poliomyelitis	Total
Total	89,32	89,32
2011	101,33	101,33
2012	96,55	96,55
2013	100,71	100,71
2014	96,76	96,76
2015	98,29	98,29
2016	94,43	94,43
2017	94,74	94,74
2018	89,94	89,94
2019	84,19	84,19
2020	74,16	76,16
2021	69,98	69,98

Figure 14: Vaccination coverage from 2011 to 2021 of the Polio vaccine, in Minas Gerais

Source: Information System of the National Immunization Program (SI-PNI/CGPNI/DEIDT/SVS/MS)

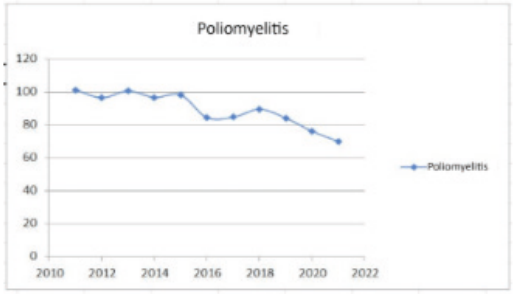


Figure 15: Dispersion diagram of vaccination coverage of the Polio vaccine, in the state of Minas Gerais, between the years 2011 to 2021

Source: Own Authorship

All vaccines analyzed in this study resulted in a shocking drop in vaccination coverage levels in Minas Gerais, reaching a drop of more than 30% compared to previous years, which implies the return of some diseases in a significant way. Therefore, it is important to list the main causes of the reduction in vaccination coverage levels in recent years, to contribute to the planning of public health measures in the state capable of changing this problematic scenario.

CONCLUSION

In Brazil, the drop in the level of vaccination in the first half of life is visible, a drop that became more pronounced over the years, as an example in the years studied, the year 2011 had a higher immunization rate compared to the year 2021, thus making low adhesion visible. It is believed that the decrease in adherence to the vaccination campaign was influenced by the success of the program itself, which guaranteed a lower incidence of diseases, generating a feeling of security in the population that the diseases would not return. Another factor impacting the drop was the population's insecurity in going to basic units during the period of the COVID-19 pandemic. Therefore, the main reason for our study is to compare the level of immunization of infants up to 6 months of age and its trends over the years 2011 to 2021. This analysis is motivated by the constant trend towards a fall in adherence to vaccination campaigns and the constant need to raise awareness among the population about the dangers of diseases and the benefits of maintaining a high vaccination rate among the population.

Our study observed that the vaccines that had the lowest adherence, in the first 6 months of life, in the State of Minas Gerais-MG, during the period studied were the Injectable Poliomyelitis (VIP) vaccine, Meningococcal C, BCG, Pentavalent, Pneumococcal 10, Rotavirus and Hepatitis B, these being in decreasing order of decline in the immunization adherence rate. In Minas Gerais, there was a common point among all vaccines, which all had an adherence of less than 80% and an average vaccination coverage of 75%, with a variation in the drop in recommended values in relation to the values found, mainly, of the VIP vaccine of 30.93%, considered the biggest drop in adherence among all immunobiologicals, and of 18.65%, of the Hepatitis B vaccine, with the smallest drop in adherence.

We concluded that in Brazil there is a drop-in vaccination coverage over time, which may imply the return of diseases considered eradicated. Therefore, it is necessary to list the main causes of the reduction in immunization levels in children aged 0 to 6 months of age, in order to strategically create public health policies to improve this disastrous scenario in the state of Minas Gerais.

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