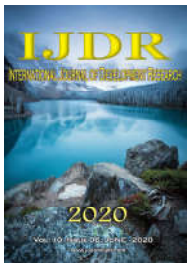
ISSN: 2230-9926

Available online at http://www.journalijdr.com

IJDR

International Journal of Development Research
Vol. 10, Issue, 06, pp. 36371-36375, June, 2020
https://doi.org/10.37118/ijdr.18933.06.2020



RESEARCH ARTICLE OPEN ACCESS

REPORTS OF COVERAGE AGAINST MEASLES, RUBELLA AND MUMPS IN MINAS GERAIS STATE – BRAZIL

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ARTICLE INFO

Article History:
Received 22nd March, 2020
Received in revised form
09th April, 2020
Accepted 04th May, 2020
Published online 25th June, 2020

Key Words:
Immunization; Measles;
Rubella; Mumps.

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ABSTRACT

Introduction: Measles is a highly transmitted acute viral disease caused by the *measles morbillivirus* agent that leads to complications such as diarrhea, otitis, pneumonia and encephalitis. Brazil had outbreaks in some of the Brazilian states. **Objective**: Analyzing the MMR records Minas Gerais state, Brazil, contained in the Information System of the National Immunization Program (SIPNI) on the *DATASUS* platform. **Methodology**: Descriptive epidemiological study, quantitative and retrospective approach.Data have extracted from DATASUS (online base) of the Brazilian Ministry of Health. The vaccine coverage of the MMR has obtained for the 1st (D1) and the 2nd dose (D2), from 2015 to 2018. All data were analyzed with Generalized Linear Models. **Results**: In 2015, D1 reached the goal of 95% in almost all regions (homogeneity = 76.92%). The vaccination coverage rate was different between years (Wald Chi-square = 33.88, p< 0.001, d.f. = 3), between doses (Wald Chi-square = 219.52, p < 0.001, d.f. = 1), and was significant for interaction between year and dose (Wald Chi-square = 78.31, p < 0.001, d.f. = 3) and significant for the macro-region (Wald Chi-square = 46.56, p p< 0.001, d.f. = 12). It is observed that D1 obtained higher values than D2 in all years evaluated. In D2, none of the years analyzed obtained the mean percentage required for coverage.

Citation: Anna Carolina Faria Sassioto Teixeira, Cecília Soares Ferreira Carilli, Clesnan Mendes-Rodrigues, Luana Araújo Macedo Scalia et al. 2020. "Reports of coverage against measles, rubella and mumps in minas Gerais State – Brazil*", International Journal of Development Research*, 10, (06), 36371-36375.

INTRODUCTION

The National Immunization Program (PNI) of Brazil organizes and manages the country's national vaccination policy and aims to control and eliminate immune preventable diseases (BRASIL, 2014). Vaccines are made available free of charge by the federal government through the Unified Health System, (SUS) (BRASIL, 2014). Among the immunobiological available, Triple Viral vaccine (MMR) immunizes the individual against measles, rubella and mumps and is recommended in the childhood vaccination schedule for two doses. The first dose (D1) administered at 12 months of age and the second dose (D2) at 15 months of age. This vaccine can also be administered in follow-up campaigns for measles vaccination and for health professionals every 10 years (BRASIL 2020, NUNES *et al*., 2018). Measles is a highly transmitted acute viral disease caused by the *measles morbillivirus* agent that leads to complications such as diarrhea, otitis, pneumonia and encephalitis. Brazil had the disease eradicated from its territory in 2016, however, it has received special attention in recent years due to the emergence of outbreaks in some of the Brazilian states. In general, measles is more severe in malnourished people, pregnant women, children under five years old and with immunodeficiencies. In pregnant women, it can cause spontaneous abortions and premature birth (BRASIL, 2013; CASTIÑEIRAS; MARTINS, 2019). As soonafter the notification of numerous cases of measles in 2018, Brazil lost its certification as a disease-free country, conferred by the Pan American Health Organization (PAHO) (MARIZ, 2019). In 2019, the country ranked the third largest number of cases of the disease, and the outbreakhas begun in the northern region of Brazil (BRASIL, 2019). In December 2019 there were 61,293 suspected cases of measles, 26% of them (15,914) confirmed and the majority coming from the state of São Paulo, Brazil (MINISTÉRIO DA SAÚDE, 2019). Although the reintroduction of the virus came from another country, the outbreak was only due to the low vaccination coverage of vaccines containing Measles virus in these populations (BRASIL, 2019). However, in 2019 cases of measles occurred in the state of Minas Gerais (MINISTÉRIO DA SAÚDE, 2019). This event has become a serious public health problem because of population numberof state (IBGE, 2018; IVETA *et al*. 2011). Studies haven't found in literature

evaluating the vaccine coverage of MMR. Thegoals of this study is to analyze the MMR records Minas Gerais state, Brazil, contained in the Information System of the National Immunization Program (SIPNI) on the *DATASUS*platform, referring to the years 2015 to 2018 and to compare the vaccination coverage of the 1st and 2nd doses among the health macro-regions of the state.

METHODS

Design: Descriptive epidemiological study, quantitative and retrospective approach.

Data Collection Procedure: Data have extracted from *DATASUS* (online base) of the Brazilian Ministry of Health (https://*DATASUS*.saude.gov.br/). *DATASUS* provides many resources to support health situation, evidence-based decision-making and development of health action programs. The measurement of the population's health status is a tradition in publichealth and withadvances in the control of infectious diseases understanding the concept of health and itspopulation determinants, the analysis of the health situation began to incorporate other dimensions of the health state. Data on morbidity, disability, access to services, quality of care, living conditions and environmental factors have become metrics used in the construction of Health Indicators, which translate into information relevant to the quantification and evaluation of health information. Moreover, *DATASUS* provide reports about health care of the population, hospitals and outpatient networks as well as financial resources and demographic and socioeconomic information. The vaccine coverage of the MMR has obtained for the 1st (D1) and the 2nd dose (D2), from 2015 to 2018. The 2019 numbers were excluded because they were not complete in the system.

Statistical Analysis: To correct the effect of time and population sizes on the vaccination coverage rate, for each macro-region sampled, the number of vaccine records applied in each macro-region was divided by the total number of the target population of each region and multiplied by 100. This metric was used as the relative vaccination coverage rate of each unit studied or vaccine coverage performed by *DATASUS*. The vaccination coverage rate of each macroregion of the state was obtained for the 1st and 2nd dose, for the years 2015 to 2018. The difference of the 1st dose minus the 2nd dose, delta dose, was also calculated to assess the loss of vaccination coverage within each year and can be interpreted as an indirect indicator of the dropout rate. To evaluate homogeneity, which measures vaccination performance and is measured in percentage or proportion (%) regions (e.g. countries, macro-regions and municipalities) with adequate vaccination coverage according to the target set for each vaccine. The target set for the triple viral is 95%. Homogeneity was calculated separately for the 1st and 2nd doses, for each of the years and only for the 13 regions. All data were analyzed with Generalized Linear Models. The data were analyzed with Inverse Gaussian distribution and identity link function (CRAWLEY, 2007). The means were compared pairwise with Least Significant Difference test. All these analyses were conducted using GLzM module of SPSS 20.0 (SPSS, Inc., Chicago, IL, USA). For vaccination coverage, we adopted in analyses fours sources of variation the year, the dose, the interaction year*dose and macroregion (block effect). Delta dose adopted in analyses two sources of variation, the year and macroregion (block effect).

RESULTS

In 2015 D1 reached the goal of 95% in almost all regions (homogeneity = 76.92%), except South, West and East South, and noregionsreached D2. In 2016 the Northwest, East south and Jequitinhonhaareadidn't reach the ideal rate for D1 and in D2 only the South, East and South-Central region reached the target. This year the Jequitinhonha macro-region reached the lowest vaccination rate in the state (77.17%). Other data related to vaccination coverage can be observed in Table 1. The vaccination coverage rate was different between years (Wald Chi-square = 33.88, p< 0.001, d.f. = 3), between doses (Wald Chi-square = 219.52, p< 0.001, *d.f.* = 1), and was significant for interaction between year and dose (Wald Chi-square = 78.31, p< 0.001, *d.f.* = 3) and significant for the macro-region (Wald Chi-square = 46.56, p p< 0.001, *d.f.* = 12).

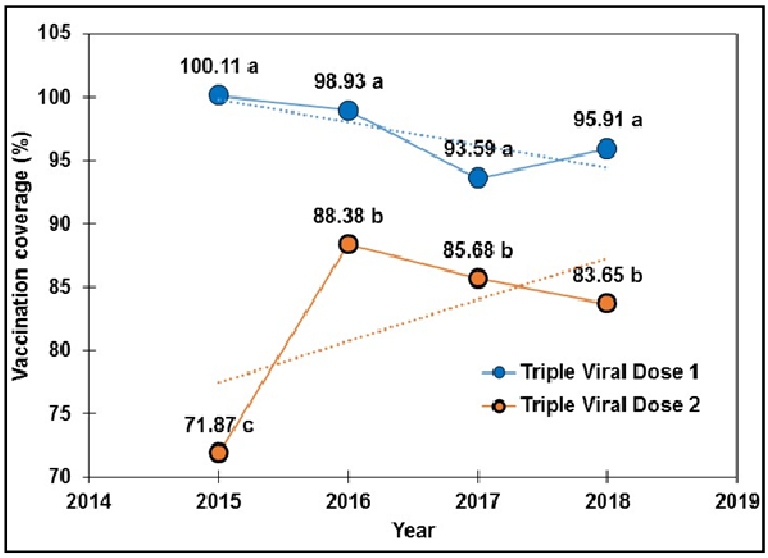
Table 1. Vaccination coverage rate (%) and homogeneity (%) MMR for the 1st dose (D1) and the 2nd dose (D2), in the health regions of the Minas Gerais state, Brazil, from 2015 to 2018

Macro-region	2015		2016		2017		2018	
	D1	D2	D1	D2	D1	D2	D1	D2
Center	97.63	78.24	97.92	85.94	88.61	82.23	92.63	80.61
South Central	105.36	67.42	102.81	97.85	105.63	97.79	102.72	90.82
Jequitinhonha	108.44	79.52	89.41	77.17	92.37	75.59	88.30	79.52
East	105.38	88.09	104.77	95.72	97.21	91.39	94.97	85.34
South East	92.48	61.76	91.14	83.68	99.52	89.10	98.46	86.90
Northeast	97.63	63.24	96.88	89.01	96.40	87.62	92.19	80.03
Northwest	102.07	61.22	90.81	83.15	98.45	88.99	100.66	85.15
North	108.92	70.29	95.27	78.79	88.57	78.21	93.20	79.93
West	93.83	60.09	98.22	87.23	94.08	84.17	97.18	83.98
Southeast	99.27	74.81	100.65	82.71	97.11	90.21	97.87	85.75
South	102.61	63.32	103.84	101.87	98.43	90.63	100.17	88.41
Northern Triangle	101.82	70.45	101.39	90.47	92.34	84.47	106.26	91.96
Southern Triangle	91.30	58.63	99.08	86.67	97.81	86.75	89.12	75.53
Homogeneity	76.92	0.00	76.92	23.08	61.54	7.69	53.85	0.00

Source: Adapted by the authors, from the National Immunization Program /*DATASUS*

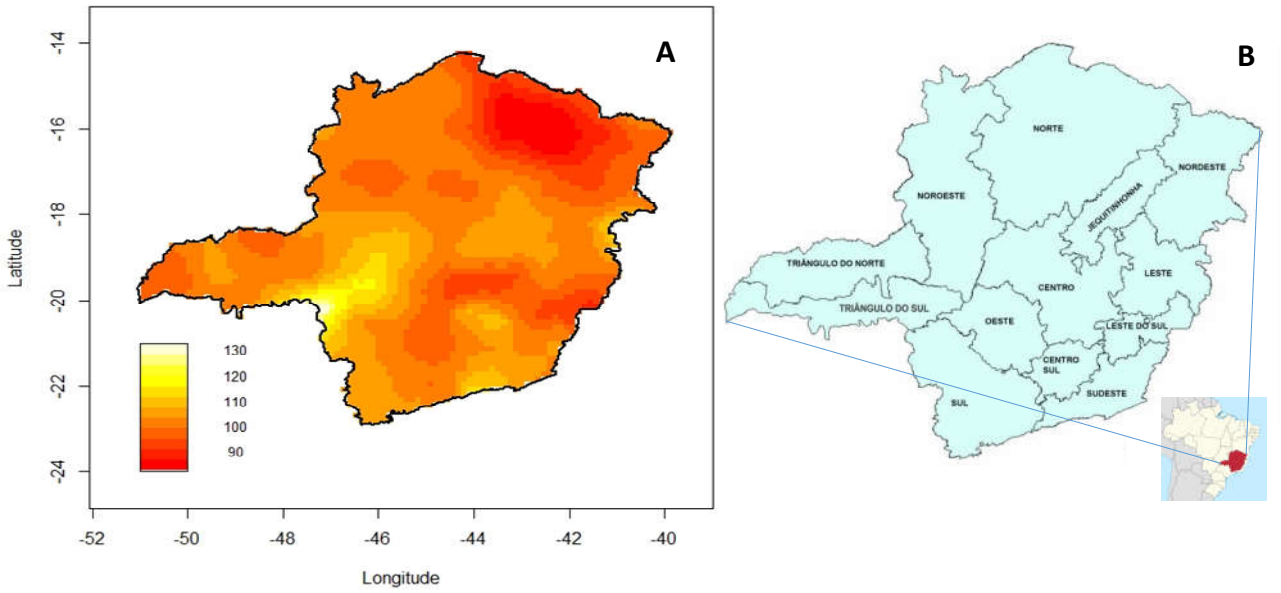
It is observed that D1 obtained higher values than D2in all years evaluated.

Graph 1 shows the rate of vaccination coverage over the years. MinasGerais state reached the goal of 95% of vaccination coverage only at doses D1 of 2015, 2016 and 2018.In 2017, 93.59% of the target audience was vaccinated. However, there wasn'tstatistical difference between coverage for D1. In D2, none of the years analyzed obtained the mean percentage required for coverage, and 2015 was the year with the lowest vaccination coverage (71.87%), followed by the others that did not differ significantly.



Source: adapted by authors, from National Immunization Program /*DATASUS*.

Graph 1. Vaccination coverage rate (%) state of Minas Gerais, Brazil, for the 1st and 2nd doses of the MMR vaccine between 2015 and 2018. Values followed by different letters differs based in Least Significance Difference test (p< 0.05). *p*



Source: Adapted by the authors, from the National Immunization Program /*DATASUS*.

Figure 1. Geographic distribution of the average vaccination coverage rate (%) between 2015 and 2018, and regardless of the dose of MMRvaccine in the state of Minas Gerais, Brazil.A: Geographical distribution of vaccine coverage. B: Macro-regions of state health and geographic positioning

Observing the estimated map of the spatial distribution of the average vaccination coverage in the macro-regions of the Minas Gerais, it is observed that the North, Northeast and Jequitinhonha macro-regions have the municipalities with the lowest vaccination coverage followed by the Central and Eastern South macro-regions. The macro-regions that show the municipalities with the highest coverage are in the confluence area of the Southern, Northwest, West and South macro-regions (Figure 1).

DISCUSSION

The study hasinvestigated the levels of MMR vaccination coverage in the state of Minas Gerais - Brazil, based on the quantitative description of the doses (D1 and D2) performed over the years 2014 to 2018. The Brazilian National Immunization Program (PNI) establishes that for the effectiveness in immunization of MMR it is necessary a rate of vaccination higher than 95% (BRAZIL, 2015). The results obtained indicate inconsistency in the execution of vaccination, evidencing the need for implementation of health actions in the state of Minas Gerais regarding immunization. In addition, the data alert the health community to the increase in the number of measles cases, as has been happening in Brazil (PACHECO *et al*., 2019b). The reduction in vaccination coverage may have a multifactorial origin in view of the heterogeneity of the country.Other outbreaks had already been reported and related to non-vaccination coverage (SECRETARY OF STATE OF HEALTH OF SAO PAULO 2010). Nurses who lead primary health care in Brazil play a crucial role in the correct execution of immunization actionsas well as in European countries. However, we can have the low vaccination rate that some Brazilian macro-regions or municipalities present are a reflection of a deficit in the number of professionals inserted in the health system, the professional devaluation by the governments, low salaries and lack of resources and work

supplies (Frade *et al*., 2017; Sousa *et al*., 2018). In Brazil in several primary care units, the vaccination room is sometimes operated by nursing technicians and not by a graduated nursewhilein other countries this function is restrictive to registered nurses because it denotes greater technical domain and scientific knowledge to ensurethe effectiveness, efficiency and effectiveness of vaccination.The management of vaccination rooms by registered nurses would result in higher rates of vaccination coverage (Sousa AD *et al*., 2018; Friar J *et al*., 2017).

Another important action related to the improvement of vaccination prevalence was the home visit, because the health team can identify children with vaccine delay through the documentary conference and identify vulnerabilitiesguiding parents on the importance of the action (Tertuliano; STEIN, 2011; Nunes *et al*, 2018). It is observed that the worst scores of vaccination coverage occurred in regions (North) where the Human Development Index has lower values (0.500) (IBGE, 2018). Economic factors are determinant for the effectiveness of health actions (Nunes *et al*., 2018; Lopes *et al*., 2005). Disease controls is possible in this case through efficient public policies and concerted efforts from different levels of government and civil society as policies dealt with key determinants (eg, the quality of water and basic sanitation, vector control), provided access to preventive resources (such as vaccines), and successfully integrated health policies with broader social assistance (Barreto *et al*., 2011; Tauil *et al*, 2017). Another reason pointed out in some studies related to vaccine delay and low vaccination coverage is the difficulty of access to health services (SANTOS *et al*., 2016; SILVA *et al*., 2018). Thus, geostatistical might be an effective tool to manage public health politics. Rate analysis about leprosy diagnosis has showed utility to choose priority areas in order to reducing number of cases and increasing health assistance in two highest populous states of Brazil (Opromolla *et al*. 2005; Almeida *et al*. 2009).

The resurgence of measles in Minas Gerais corroborates the fact that the number of measles cases has increased since 2018 in other regions of the country (Secretaria do Estado de Minas Gerais, 2019; (Minas Gerais State Department, 2019; Secretaria de Estado de Minas Gerais, 2019b). Emergence new cases could still higher if no efficient strategies to improve vaccination coverage rates start to run. Vaccination actions are not only the responsibility of the Ministry of Health, but of multiple partners, even parents or guardians of the child, the school environment and health services. This should be guaranteed by the child health care network through the good quality of inputs and immunobiological, the training of health professionals and health education on the importance of vaccine updating for community health. Some objections still make themselves relevant as the current anti-vaccine movement. Fake news about side effects, erroneous statements from experts may interfere with low vaccination coverage or adherence of the population in the act of vaccinating or vaccinating their children (Carrieri V *et al*., 2019).

Conclusion

Minas Gerais state is presenting a drop in vaccination coverage rates of MMR in the 1st and 2nd doses. These resultsincrease the idea of epidemiological vulnerability to a measles outbreak. Public health policies should be protagonists in immunization and adequate vaccination coverage through multisectoral actions.Furthermore, understanding the spatial scenario of this coverage offers new perspectives for public actions prioritizing areas of low vaccination coverage, which may be associated with socioeconomic and environmental factors.

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