Chapter 35

Measles and Rubella: susceptibility in adolescents, young adults in Belém and Ananindeua, Pará, Brazil

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Marluce Matos de Moraes
Instituto Evandro Chagas/MS, Ananindeua, Pará, Brazil
marlucemoraes@iec.gov.br

Dorotéa Lobato da Silva
Instituto Evandro Chagas/MS, Ananindeua, Pará, Brazil
dorotealobato@iec.gov.br

Renato Lopes Fernandes de Medeiros
Instituto Evandro Chagas/MS, Ananindeua, Pará, Brazil
renatomedeiros@iec.gov.br

Maria Izabel de Jesus
Instituto Evandro Chagas/MS, Ananindeua, Pará, Brazil
mariajesus@iec.gov.br

Fernanda do Espírito Santo Sagica
Instituto Evandro Chagas/MS, Ananindeua, Pará, Brazil
fernandasagica@iec.gov.br

ABSTRACT
Measles and Rubella are infectious viral diseases, exanthematous, contagious, transmitted by the respiratory tract, similar clinical pictures that can evolve with severe complications. There is no specific treatment so far, both are of universal distribution, prevention is through vaccination. Objective: to evaluate the immune status in population aged 15 to 39 years as to measles and rubella, identifying susceptible between 2016 to 2018 in the municipalities of Belém and Ananindeua, Pará, Brazil. The detection of human IgG antibodies in blood serum were performed by the ELISA method. Considered susceptible individuals with non-reactive and inconclusive titers. In Belém, 1109 residents participated, the susceptible age groups for measles were 15 to 19 years (22.4%); 20 to 29 years (16.2%) and 30 to 39 years (8.8%). Ananindeua obtained 1111 participants, the age groups 15-19; 20-29; 30 to 39 years were vulnerable to measles virus, presenting susceptibility of 21%, 17.7% and 9.5% respectively, for rubella the age group 15 to 29 years was susceptible. There is a risk of measles and rubella outbreaks in the municipalities studied, pointing to the need to strengthen vaccination strategies, border monitoring, because the immigration of unvaccinated foreigners has contributed to the occurrence of measles outbreaks in Brazil in the last five years, causing the loss of certification of elimination of measles, and the threat of reintroduction of the rubella virus to Brazil.

Keywords: Measles; Rubella; Epidemiology

1 INTRODUCTION

Measles and Rubella are exanthematic, infectious viral diseases that are easy to contagion, with transmission through theairways, with a similar clinical picture, which can evolve with severe complications. Both are universally distribution and arenot specific treatment and the best way to prevent them is through vaccination (Brasil, 2021).

Measles became part of the group of diseases eliminated in the Americas from the 21st century on, and other countries still have cases and epidemics. Rubella, because it is a disease whose epidemiological surveillance actions are carried out together with those of measles, is also part of this group of eliminateable diseases (Brasil, 2021).

Despite the availability of the safe and effective triple viral vaccine, there have been more than 140,000 measles deaths worldwide, mainly among children under the age offive and in 2018. The import of the virus and low vaccination coverage in developed countries still exist, and are predisposing factors for epidemics (PAHO, 2019).

Measles outbreaks have been reported in cohorts vaccinated at only one dose (Fernandez, 2021). The vaccine currently used has a seroconversion efficacy of 95%, but there are factors, such as primary vaccine failures (PVF), when the body does not respond to immunization that for measles and rubella, around 2% to 5% (Bautista-Lopes et al., 2000; ST Sauver et al., 2001).

The presence of maternal antibodies and the improper conditions of the vaccine (cold chain, handling, administration) are among the main causes of PVF. There are also secondary vaccine failures (FVS), which is when antibody levels deflate over time reaching low levels, no longer providing protection. Even with an adequate immunization program, vaccine failures promote a susceptible action after a few years. Therefore, vaccination coverage does not equal population immunity (Wild, 1999; CDC, 2020; Devecioğlu et al., 2018).

The recommendation to maintain high levels of immunity and to stop the chain of transmission of the viruses in question (measles and rubella) is to maintain homogeneous vaccination coverage of 95% and to comply with the dose regimen recommended by the Ministry of Health: at 12 months (1st dose), triple viral (SCR); at 15 months (2nd dose) tetraviral (SCR-V); atdultos up to 29 years of age, without history of vaccination should receive two doses of CRS, with an interval of 30 days; between 30 and 49 years, only one dose with the purpose of avoiding vaccine failures and recovering eradication in the country (Brazil, 2020a).

Between 2001 and 2005, ten cases of measles were confirmed in Brazil**,** with identification of genotypes D4 and D5 (Japan, Europe and Asia). In 2006, 57 cases were confirmed in two isolated outbreaks in the State of Bahia, with genotype D4, and the primary source of infection was not identified (Ribeiro; Mark; Lamas, 2015).

In 2010, 68 cases of measles were recorded, among these, three cases in Belém do Pará, all considered imported, whose genetic analysis identified genotype D4, similar to that found in outbreaks in the European continent (Jesus et al., 2015).

In 2011, 43 cases of measles were recorded; in 2012there were 220 confirmed cases of measles; in 2014 , 769 cases were reported in the Northeast, with 698 confirmed in Ceará, in Pernambuco 24 and 7 cases in São Paulo (Brazil, 2016). The circulating genotype in epidemics in Pernambuco and Ceará is D8. These cases are focusing on tourist areas, which indicates that the origin of these cases may be from tourists from other continents, where there is still the circulation of the said virus. England recorded more than 3,000 cases in 2013 and the Netherlands more than 1,000 (Ribeiro; Mark; Lamas, 2015).

The State of Ceará experienced an increase in the number of measles cases that last 15 months, which was considered subsequent to the measles outbreak in Pernambuco, which occurred in 2013 and 2014. The declaration of restoring the circulation of the measles virus in the country and in the Americas is being considered, as the condition of endemic site for measles occurs after 12 months with confirmationof cases uninterruptedly. In 2015, until epidemiological week 12 (01/01 to 25/03/2015) 90 cases were confirmed in Ceará and one case in Roraima, all considered as imported or secondary cases, and genotypes D4, G3, D8 and B3 were identified, which circulated on the European and African continents. (Ribeiro;

Mark; Lamas, 2015). Afterv. v. strategiesto control the disease, they were adopted in order to eliminate the circulation of this virus in Brazil.

Three or four decades ago, thousands of cases of measles were reported per year in Brazil, as there was fragility in surveillance in relation to current strategies. Measles was one of the diseases with the highest mortality in children (CDC, 2021). In 2015, most of the notifications recorded came from regions of Africa, the Western Pacific, Southeast Asia and India and Europe (Patel *et al*., 2016). In September 2016, after more than 12 months without registering cases, it was certifiedto the elimination of measles in the Americas ("Brazil free of measles", PAHO, 2016).

Despite advances in control, and elimination has been evident, a setback has been observed as the country experiences the resurgence of the disease throughout the national territory, especially in the North region in 2018 (probably due to the failure in vaccination coverage), which recorded 10,326 confirmed cases , from Venezuela and other countries that still had endemic cases, with a higher incidence in the states of Amazonas, Roraima and Pará, and Brazil lost the certification of elimination in 2019, for presenting cases for more than 12 months. Additionally, in the same year, 18,203 cases were confirmed in 23 Brazilian states, most in São Paulo, with 15 deaths nationwide (Brasil, 2019a).

In 2020, 21 Brazilian states confirmed 8,448 cases of measles, of which 5,375 in the state of Pará, with five deaths. In 2021 , 668 confirmed cases were detected, 527 in the state of Amapá, with two deaths, followed byPará (115 cases), Alagoas (11 cases), São Paulo (9 cases), Ceará (3 cases) and Rio de Janeiro (3 cases). Between the 49th Epidemiological Week of 2021 and 8th of 2022, 217 suspected cases of measles were reported; of these, 10 were confirmed cases by laboratory criterion (Brasil, 2020b).

Rubella, before being integrated into measles surveillance, was not a disease of compulsory notification. Peroodo considered the e nd êmico-epidêmica, occurring in children, adolescents and young adults, and when it affected pregnant women, it caused congenital rubella syndrome. Resolution CD47 was approved in 2006 by the Board of Directors of the Pan American Health Organization (PAHO). R10, which deals with the maintenance of measles elimination in the countries of the Americas, which recognized the importance of maintaining the epidemiological surveillance of measles, rubella and CRS, as well as vaccination strategies that were implemented to achieve these objectives (PAHO 7 WHO, 2007; PAHO, & WHO,2017).

In the State of Pará, according to information from the National System of Notifiable Diseases (SINAN), 16 cases of CRS were detected between 2000 and 2009, and in 2008 there were several outbreaks of rubella in Brazil including Pará, with 284 cases of the disease in the municipalities of Ananindeua, Prainha and Parauapebas (Moraes et al., 2015).

Intensifying epidemiological surveillance, blockade vaccination was performed in 2008 in Brazil, including, in addition to women of childbearing age, men aged 19 to 39 years, which reached a vaccination coverage of 94% and had as response to the reduction in the number of rubella cases by 273.6% (6,109/8,342), when compared to 2007, and 84% of the cases were diagnosed by laboratory (Brazil 2008).

In view of the efforts made, Brazil reached the goal of eliminating Rubella and CRS, until 2010 and in the period from 2010 to 2014, no rubella cases were confirmed in the country, receiving certification in 2015 (PAHO &WHO, 2015).

2 METHODOLOGY

Based on the star guidelines, 2018 this study was observational, cross-sectional of a population selected by conglomerates, where participants were selected by drawing from the listings of public and private schools and colleges in the municipalities of Belém and Ananindeua, totaling 15 educational establishments, three barracks and a research institute, corresponding to the criterion of stratification in three age groups (15-19; 20-29; 30-39) in healthy individuals of both sexes. Students aged 15 to 19 years were selected in high school schools, for the other age groups in question, the selection was held in colleges, universities, barracks and research institute in each municipality of the study.

Participants were invited to participate by spontaneous demand. After interviewing and signing the free and informed consent form and nod term for children under 18 years of age, blood samples with 6 mL of each participant were collected by venous puncture, obtaining the serum to be used to perform qualitative and quantitative tests for the detection of IgG antibodies specific to measles and rubella viruses, which were centrifuged at 3,000 rpm for 15 min, separated into 500 µL aliquots and stored at -20 ºC. At the end of the collection phase, serologies were performed using the Enzyme-Linked Immunosorbent Assay (ELISA) method, with the siemens® laboratory kit, Marburg, Germany. The technique is the same for both diseases, the tests contain microtitration plates with 96 wells, coated with inactivated antigen of vs or VR and performed according to the manufacturer's instructions. The quality control used was the reference of the Kit itself with sensitivity of 99%.

According to an estimate by the Brazilian Institute of Geography and Statistics (IBGE), the municipality of Belém in 2012 had 1,410,430 inhabitants, distributed in 127,580 inhabitants aged 15 to 19 years, 276,156 inhabitants aged 20 to 29 years and 237,263 inhabitants aged 30 to 39 years (PMB, 2012). Ananindeua had 499,776 inhabitants in 2012, distributed in 46,530 inhabitants aged 15 to 19 years; 97,353 inhabitants aged 20 to 29; 83,483 inhabitants aged 30 to 39 (Gusmão, 2017).

Because it is a stratified sampling, the OpenEpi application was used, proportion command, using the parameters Maximum Estimated Prevalence (80%), Confidence Limit (5%), Confidence Level (95%) and The Adjustmentby Del ineamento Effect (deff=1.5), essential to control confounding factors, as well as loss of power of the statistical test used to calculate the sample size. The calculation was performed by applying the following formula:

$$\text{Sample size } \boldsymbol{n} = [EDFF*Np(1-p)]/\ [(d^2/Z^2_{1-\alpha/2}*(N-1)+p*(1-p)] \quad (1)$$

When performing the sample calculations, the stratification by representative age group would be at least 2,210 participants, independent of gender, 1,107 from Belém and 1,103 from Ananindeua, distributed in the following age groups: 15 to 19 years (369 from Belém, 367 from Ananindeua); 20 to 29 years (369 from Belém, 368 from Ananindeua); and 30 to 39 years (369 from Belém, 368 from Ananindeua). This sampling would be sufficient to detect the statistical differences considered significant from the alpha level of 5% (= 0.05) and 95% CI, considering possible losses in the sample collection process. The sample of this study exceeded the sample calculation with a total of 2,220 individuals, obtained between the years 2016 and 2018, 1109 for Belém and 1111 in Ananindeua.α

The interpretation of the results based on optical reading was made according to the criteria below for measles and rubella: Anti VS/IgG negative *ΔE < 0.100 (limit value); Anti VS/IgG positive ΔE > 0.200; Anti VS/IgG limit value 0.100 ≤ ΔE ≤ 0.200; *ΔE = Absorbance Delta and Negative Anti VR/IgG *ΔE < 0.100 (limit value); Anti VR/IgG positive ΔE > 0.200; Anti VR/IgG limit value 0.100 ≤ ΔE ≤ 0.200; *ΔE = Absorbance Delta respectively.

The quantitative interpretation of the samples with IgG antibody activities higher than the limit value was calculated with the aid of the α. The calculation could not be included: the measured values (ΔE) corrected < limit value and the uncorrected ΔE ≥2.5. They were placed in a dilution of 1+2310 for the interpretation to be valid. The calculation of mIU/mL for measles and IU/mL for rubella was made according to the following formula:

$$\log10\ mIU/mL = \alpha \times \Delta E\ \beta \quad (2)$$

The values depending on the batches for the α and β were read from the bar code value table of the kit used.

For the quantification of the tests, antibody concentrations (mIU/mL) by optical density (O) were expressed, according to the cutoff values provided by the manufacturers. The threshold values, considered immunoprotective, were IgG >350 mIU/mL titium, negativity <150 mIU/mL and inconclusive levels between 150 – 350 mIU/mL for measles. For rubella, IgG tides for seronegativity were considered <4 IU/mL, seropositivity >6.3 IU/mL and inconclusive ones of 4 – 6.3 IU/mL. The DO/IgG titles obtained were typed in an Excel spreadsheet, provided by the manufacturer (Alpha Evaluation of virolog. Enzygnost IgG Test), taking into account the correction factors.

Individuals with non-reactive titers (IgG\u2012) and inconclusive for measles and rubella-specific IgG antibodies were considered susceptible, and those who had reactivity with antibodies (IgG+) considered immune.

The vaccination coverage of the period studied in the selected municipalities were taken from the Information System of the National Immunization Program (SI-PNI), available by the Department of Informatics of SUS (DATASUS).

In the EPI-INFO 7.0 program, the questionnaires were digitized and stored as a database. For the graphic constructions and tables, the Microsoft Office Exel 2007 programs were used. The statistical tests used for theanalysis were non-parametric binomial for a proportion; Chi-square; Tthis G of Williams; Tthis of two independent binomial samples for two proportions by the BioEstat 5.3 Program, considering *significance level* $p < 0.05$.

As established by Ordinance No. 466/2012 of the National Research Council, the study was approved by the Research Ethics Committee (CEP) of the Evandro Chagas Institute under Approval Opinion No. 2556024, providing the privacy of information and anonymity of the research subjects (Brasil, 2012).

3 RESULTS

In the municipality of Belém, 1,109 participants were investigated, 32.7% (363/1109) male and 67.3% (746/1109) female. The age group from 15 to 19 years presented 24.4% susceptibility to measles (95% CI 17.5 - 25.5) and rubella 11.3% (95% CI 2.7 - 18.9); andthe individuals aged 20 to 29 years were 16.1% (95% CI 12.9 - 18.5) for measles and 6.6% (95% CI 5.0 - 8.0) for rubella; and in the age group from 30 to 39 years, it reached values of 8.8 (95% CI 5.5 - 11.8) and 3.8 (95% CI 1.7 - 5.9) respectively. A significant difference was confirmed between the frequencies of susceptible, for the two pathologies, both by age group and in relation to gender ($p < 0.05$), except among women aged 30 to 39 years ($p > 0.05$). Comparing the frequency of men and women nage groups for both antibodies, only a significant difference was observed in the age group from 30 to 39 years for measles ($p < 0.05$) (table 1).

Table 1 - Susceptibility of Measles and Rubella tested by the research of specific IgG antibodies, by gender and age group, in the municipality of Belém, Pará, Brazil , 2016 to 2018

		Measles			Rubella			
Age group	**Total**	**S**	**%**	**(95% CI)**	**S**	**%**	**(95% CI)**	**†p-value**
15 - 19	326	73	**22,4**	17,5 – 25,5	37	**11,3**	2,7 – 18,9	< 0.0001
Male	92	21	22,8	14,1 – 30,4	10	10,9	4,4 – 15,2	0,0151
Female	234	52	22,2	16,7 – 26,5	27	11,5	8,1 – 15,4	< 0.0001
*** P-value**	0,4531				0,2254			
20 -29	545	88	16,1	12,9 – 18,5	36	6,6	5,0 – 8,0	< 0.0001
Male	186	35	18,8	13,5 – 23,7	12	6,5	3,8 – 9,7	0,0002
Female	359	53	14,8	11,4 – 18,1	24	6,7	4,5 – 9,2	0,0002
*** P-value**	0,1113				0,4585			
30 -39	238	21	8,8	5,5 – 11,8	9	3,8	1,7 – 5,9	0,0118
Male	85	12	14,1	7,1 – 20,0	3	3,5	0,0 – 7,1	0,0075
Female	153	9	5,9	8,5 – 19,0	6	3,9	1,3 – 6,5	0,2135
*** P-value**	0,0159				0,4396			

Source: Authors. S = Susceptible *****: statistics between the sexes † : statistics between pathologies
†*p* = Binomial test for two proportions

In Ananindeua, the study included 1,111 participants, 66.2% (736/1111) female and 33.8% (375/1111) male. Between the age group 15 to 19 years, the susceptibility to measles and rubella was 21% (95% CI 17.7 - 23.9) and 14.6% (95% CI 12.37 – 17.5) respectively; for the age group from 20 to 29 years,

it was 17.7% (95% CI 14.2 - 21.2) and 8.3% (5.0 - 10.3) respectively; and among those aged 30 to 39 years, 9.5 (95% CI 5.3 - 12.1) and 2.6 CI 95% 1.1 – 4.7) respectively. Statistically analyzing a significant difference between the frequencies susceptible to the two viruses both in relation to age groups and in relation to gender. When analyzing the frequencies of susceptible between men and women, a difference was verified only in the age group from 15 to 19 years in relation to measles (p <0.05) (table 2).

Table 2 - Susceptibility of Measles and Rubella tested by the research of specific IgG antibodies, by gender and age group, in the municipality of Ananindeua, Pará, Brazil , 2016 to 2018

	Measles				Rubella			
Age group	**Total**	**S**	**%**	**(95% CI)**	**S**	**%**	**(95% CI)**	**†p -value**
15 - 19	582	122	21,0	17,7 – 23,9	85	14,6	12,3 – 17,5	0,0023
Male	206	51	24,7	19,4 – 30,1	35	17,0	12,1 – 21,4	0,0262
Female	376	71	18,9	15,2 – 22,1	50	13,3	9,6 – 15,7	0,0186
*** P-value**	0,0480				0,1139			
20 -29	339	60	17,7	14,2 – 21,2	28	8,3	5,0 – 10,3	0,0001
Male	104	20	19,2	11,5 – 25,0	8	7,7	2,9 – 12,5	0,00074
Female	235	40	17,0	12,4 – 20,9	20	8,5	5,0 – 11,9	0,0029
*** P-value**	0,3115				0,4004			
30 -39	190	18	9,5	5,3 – 12,1	5	2,6	1,1 – 4,7	0,0026
Male	65	9	13,8	6,3 – 20,3	3	4,6	0,0 – 9,2	0,0345
Female	125	9	7,2	3,2 – 10,4	2	1,6	0,0 – 4,0	0,0379
*** P-value**	0,0689				0,1090			

Source: Authors. S = Susceptible *****: statistics between the **sexes** †:statist ica between viruses
†p = Binomial test for two proportions

When investigating the seroprevalence of the association of measles/rubella, the history of infections was recorded by 6.5%, 3.8% of the participants, respectively. The history of immunization against measles/rubella, excluding those with a history of diseases, was reported in 72.3% and 53.7%, respectively. Damong those who reported having contracted measles, 100% had positive serological test, and in rubella 96.4%. Regarding the receipt of the measles and rubella vaccine, 82.4% had seroconversion for measles and 92.0% for rubella (Table 3).

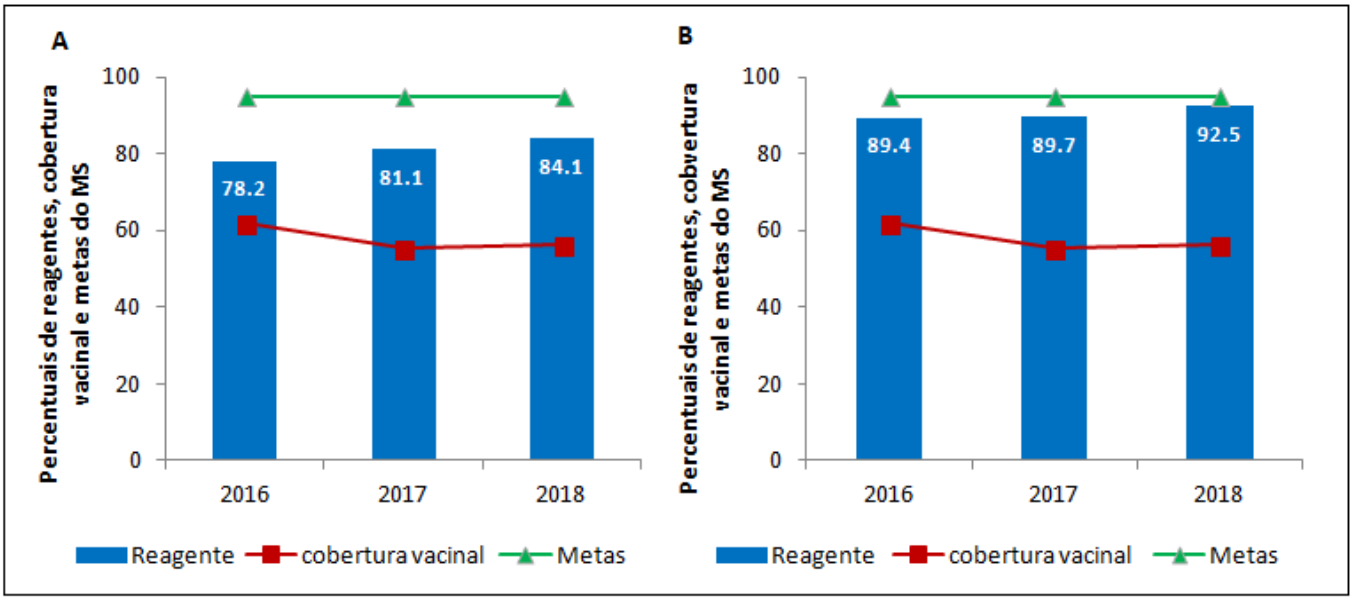
Table 3 - Association of seroprevalence for measles/rubella with history of the disease and history of vaccination (excluding those with reported having contracted measles and or rubella) in Belém and Ananindeua, Pará, Brazil 2016 to 2018

Measles						
Situation	**Total**	**%**	**Immune**	**%**	**Susceptible**	**%**
History of the disease	145	6,5	145	100,0	-	0,0
Did Not Contract	1758	79,2	1.441	82,0	317	18,0
Don't you know	317	14,3	252	79,5	65	13,3
Received Vaccine	1501	72,3	1.237	82,4	264	17,6
Did Not Receive	32	1,6	22	68,8	10	31,2
I couldn't tell you	542	26,1	434	80,1	108	19,9
Total	**2075**	**100,0**	**1.693**	**81,6**	**382**	**18,4**
Rubella						
History of the disease	84	3,8	81	96,4	3	3,6
Did Not Contract	1678	75,6	1.536	91,5	142	8,5
Don't you know	458	20,6	403	88,0	55	12,0
Received Vaccine	1147	53,7	1055	92,0	92	8,0
Did Not Receive	94	4,4	80	85,1	14	14,9
I couldn't tell you	895	41,9	804	89,8	91	10,2
Total	**2136**	**100,0**	**1.939**	**90,8**	**197**	**9,2**

Source: Authors
–: Numerical data equal to zero.

The frequency of reactive antibodies (seropositive) for measles (A) and rubella (B) in the municipalities studied in 2016 were 78.2% and 89.4% respectively. In 2017, 81.1% of the participants were seropositive for measles and 89.7% for rubella. In 2018, they presented immunity for measles 84.1%, and 92.5% for rubella. In the three years investigated (2016, 2017 and 2018),vaccination coverage recorded 61.9%, 55.3% and 56.2%, respectively. Statistically analyzing the results of measles and rubella in the total of three years by binomial testing of two samples, a significant difference was observed (p <0.0001) (Figure 1).

Figure 1 - Frequency of IgG antibodies for measles (A) and rubella (B)/ Vaccination coverage and DM targets, in Belém and Ananindeua,Pará, Brazil, 2016 to 2018



Source: Authors. p <0,0001 - DATASUS

4 DISCUSSION

This articleallowed a nalysis on susceptibility to viral infection by measles and rubella in two municipalities of Pará, Brazil, between the years 2016 to 2018, verifying that there is still susceptibility to measles and rubella virus, due to the low vaccination coverage, which even after the elimination of these diseases that reached the goal established by the Ministry of Health, it was unable to maintain the 95% coverage, and may be associated with shortages, even in the short term, giving way to the strong influence exerted by anti-vaccine movements in a global nature, which using digital media use the information without attest to the veracity eventually sharing them. A study conducted in Brazil based on the 3C's model indicated that "fake News" may lead to vaccine hesitation (Frugoli et al., 2021) and Domingues et a., 2020 reports in their study a point that may be associated with difficulty in vaccination as the irregularity in the supply of immunobiologicals, resulting from production problems both related to the production process of public and private laboratories.

In recent years, there has been a global upsurge in the occurrence of measles and rubella outbreaks, especially in countries in the Western Pacific and Southeast Asia (Garcia et al., 2020). Measles and rubella

have integrated surveillance throughout Brazil, with the objective of timely detection of cases, aggregates and outbreaks of febrile exanthematic diseases, aiming at the proper implementation of control measures (PAHO, 2017).

Despite the numerous vaccination campaigns against measles and rubella, percentages of unacceptable susceptible scans were still observed in this seroepidemiological survey conducted in two municipalities of Pará (Belém and Ananindeua)." These resultados were similar tothose found in the study by Ferraciolli et al.,2020 that analyzed or susceptibility of measles in northern Brazil. Andin both municipalities, a significant difference was detected between susceptibility to measles *versus rubella*, since for rubella the percentages of susceptible were lower than for measles, being directly proportional to the decrease in age group (the younger, the more susceptible).

Regarding rubella, the age group from 30 to 39 years of age followed the criteria standardized by the DM, which should reach ≥5. The study by Moraes et al, 2015 showed the decline in the occurrence of rubella cases in the state of Pará, enabling elimination and Oliveira et al., 2016 reported susceptibility of 5.6% for rubellaand pregnant ntre in a municipality of Maranhão. Because rubella is a pathology in which 50% of cases can be subclinical, many acquire natural immunity, and these cases are not reported. In these cases, the disease will only be identified when cases of congenital rubella syndrome arise after epidemiological investigation. This justifies the higher percentage of immunity for rubella when compared to measles, as the same vaccine is used for both viruses.

In Belém, measles susceptibility showed statistically different frequencies inrelation to gender, showing that males aged30 to 39 years weremore susceptible to females. Regarding gender, a similar pattern was observed in Ananindeua, however, the highest percentage of susceptible patients was observed in men agedbetween 15 and 19 years. For rubella, there were no significant differences in relation to gender in both municipalities. Ferraciolli, Magalhaes and Fernandes, 2020, when studying susceptibility tomeasles in relation to sex, recorded higher frequencies of susceptible among males, mainly due to the low support of men to vaccination, evidencing that they are more vulnerable to diseases because they do not seek primary care services like women. Regarding rubella, studies by Arunkumar, Vandana and Sathiakumar in 2013 showed different results, observing a higher percentage of susceptibility among women.

Less than one-tenth of the individuals reported a suggestive history of measles and rubella, and their susceptibility showed negligible proportions. However, for those who reported having received the measles/rubella vaccine, susceptibility was significantly relevant, especially for measles. The results found in the present study show that individuals who were immunized in childhood or adolescence may become susceptible as adults and, consequently, women could transfer low levels of maternal antibodies to their children. This fact confirms the need to comply with therecommendations of the MH regarding the orientation for the second dose, in order to correct possible primary and secondary vaccine failures (Wiedermann, Garner-Spitzer and Wagner, 2016). Findings by Kato et al. , (2016) demonstrated that igg

antibody titers for measles and rubella induced by natural infection were higher than those induced by the vaccine.

The percentage of individuals with antibodies reactiveto measles/rubella virus in the three years studied did not reach 95%. According to data from the National Immunization Program, provided by DATASUS, vaccination coverage for measles/rubella in the state of Pará between 1998 and 2018 was 79.5%. After the implementation of double viral (2000) and triple viral (2003) vaccines, coverage of coverage established by the MH (≥95%) was recorded until 2012, declining from 2013, reaching 53.2% in 2018, demonstrating a percentage far below the desired, which led to the creation of pockets of susceptible (Brazil 2019b) This may be related to the defueling of immunobiologicals, the immigration of unvaccinated foreigners and the dissemination of "fake news" about vaccines, causing doubts in the population about immunization and its benefits. It is important to note that, even in the short term, the influence of anti-vaccine movements on a global level, in which citizens use digital media and share information without attest to the veracity of them. A study conducted in Brazil, based on the 3C's model, indicated that "fake news" may lead to vaccine hesitation (Frugoli et al., 2021), and may decrease the adhering to vaccination regimens, which would probably be related to the recirculation of the measles virus in the country since 2018, which causesor outbreaks and led to the loss ofelimination certification in 2019. It is noteworthy that there is also a risk for the occurrence of rubella and congenital rubella syndrome.

5 CONCLUSION

The analysis on measles and rubella susceptibility in the two municipalities of Belém and Ananindeua, Pará, Brazil, between 2016 and 2018, showed that there is still susceptibilityto measles and rubella viruses due to poor vaccination coverage, since from the serological tests used in the identification of immune, the percentage presented did not reach 95%, showing that vaccination coverage in the last ten years did not reach the goal set by the Ministry of Health of 95%,which even after the elimination of these diseases and the achievement ofthe established goal, could not maintain the recommended coverage level and consequently occurred the reintroduction of measles in 2018, with the risk of rubella outbreaks. Culminating in 2019 with the loss of measles elimination certification. It is important to note that in 2020 the Covid-19 pandemic occurred resulting in the isolation of the population, the vaccination schedule of that same year was impaired, in addition to the circulation of false news by anti-vaccine movements in social networks, causing an increase in cases in the state of Pará, which segund o Epidemiological Bulletin No. 51 of Ten of 2020 (Brazil, 2020b) represented 63.8% of the total confirmed cases in the country. Since vaccination is the main public health strategy as a preventive form of the spread of the virus, it is important to engage health professionals as active members of true information in immunobiological s , raising awareness of the safety, efficiency and need of immunization which are also epidemiological surveillance measures to increase vaccination coverage and prevent the reintroduction of rubella virus and recover measles certification.

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