HESITAÇÃO VACINAL NA REGIÃO METROPOLITANA DA BAIXADA SANTISTA E SUA INFLUÊNCIA NA VACINAÇÃO DE CRIANÇAS DE ATÉ DOIS ANOS DE IDADE

VACCINATION HESITATION IN THE METROPOLITAN REGION OF BAIXADA SANTISTA AND ITS INFLUENCE ON THE VACCINATION OF CHILDREN UP TO TWO YEARS OF AGE

LA VACUNACIÓN EN LA REGIÓN METROPOLITANA DE LA BAIXADA SANTISTA Y SU INFLUENCIA EN LA VACUNACIÓN DE NIÑOS DE HASTA DOS AÑOS

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RESUMO

A baixa cobertura vacinal tem gerado preocupações nos sistemas de saúde em todo o mundo, devido ao risco de reemergência de doenças já eliminadas. Um dos principais fatores que contribuem para essa baixa cobertura é a hesitação vacinal, definida como o atraso ou recusa em aceitar vacinas recomendadas, mesmo quando estas estão disponíveis. Diante desse cenário, o objetivo deste estudo foi analisar a hesitação vacinal na Região Metropolitana da Baixada Santista e sua influência na vacinação de crianças de até dois anos de idade. Este estudo epidemiológico transversal foi realizado por meio de um inquérito domiciliar sobre a cobertura vacinal infantil (0 a 2 anos) nos municípios da Região Metropolitana da Baixada Santista. A amostra probabilística incluiu 831 participantes, com nível de significância de 5% e poder de 80%, e o levantamento ocorreu entre novembro de 2020 e abril de 2022. A análise utilizou testes de associação e a escala Likert para medir o grau de hesitação vacinal. Os resultados indicam que 74% dos respondentes eram mães, com maioria de escolaridade de ensino médio completo ou superior incompleto (54%), idade entre 30 e 39 anos (44,5%), e 53,5% trabalhando fora do lar. As crianças eram majoritariamente brancas (56,2%) e levadas pelas mães para vacinar (77,3%), sendo as Unidades Básicas de Saúde (UBS) o principal local de vacinação (92,4%). Além disso, 16,8% dos respondentes afirmaram que a pandemia de Covid-19 influenciou a não aplicação de vacinas. A análise indicou associação significativa ($p<0,05$) entre hesitação vacinal e as áreas geográficas da região. A Área Norte apresentou o maior percentual de hesitação vacinal, embora a hesitação tenha sido significativa em todas as áreas. Os testes de múltiplas comparações de Bonferroni e Kruskal-Wallis revelaram diferenças entre as regiões em termos de hesitação vacinal. Com base no conceito de vulnerabilidade de Ayres, que considera a interação entre fatores individuais, sociais e programáticos, o estudo destaca que a hesitação vacinal na região é multifacetada. Fatores que se enquadram nos 5Cs (Confiança, Complacência, Conveniência, Cálculo e Responsabilidade Coletiva) foram identificados em todas as áreas. Portanto, o combate à hesitação vacinal deve envolver estratégias territorialmente adaptadas, considerando as especificidades regionais e culturais para promover maior aceitação das vacinas.

Palavras-chave: Hesitação vacinal. Imunopreveníveis. Cobertura vacinal.

ABSTRACT

Low vaccination coverage has raised concerns in health systems worldwide due to the risk of reemerging diseases that have already been eliminated. One of the main factors contributing to this low coverage is vaccine hesitancy, defined as the delay or refusal to accept recommended vaccines, even when they are available in the healthcare system. In this context, the objective of this study was to analyze vaccine hesitancy in the Baixada Santista Metropolitan Region and its influence on the vaccination of children under two years of age. This cross-sectional epidemiological study was conducted through a household survey on infant vaccination coverage (0 to 2 years) in the municipalities of the Baixada Santista Metropolitan Region. The probabilistic sample included 831 participants, with a significance level of 5% and a power of 80%, and the survey was conducted from November 2020 to April 2022. The analysis used association tests and the Likert scale to measure the degree of vaccine hesitancy. The results indicate that 74% of respondents were mothers, with the majority having completed high school or some college education (54%), aged between 30 and 39 years (44.5%), and 53.5% working outside the home. The children were mostly white (56.2%) and were primarily taken by their mothers to be

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vaccinated (77.3%), with Basic Health Units (UBS) being the main vaccination site (92.4%). Additionally, 16.8% of respondents stated that the COVID-19 pandemic influenced their decision not to vaccinate. The analysis showed a significant association ($p<0.05$) between vaccine hesitancy and geographic areas within the region. The Northern Area had the highest percentage of vaccine hesitancy, although it was significant across all areas. Bonferroni multiple comparisons and Kruskal-Wallis tests revealed differences between the regions in terms of vaccine hesitancy. Based on Ayres' concept of vulnerability, which considers the interaction between individual, social, and programmatic factors, the study highlights that vaccine hesitancy in the region is multifaceted. Factors associated with the 5Cs (Confidence, Complacency, Convenience, Calculation, and Collective Responsibility) were identified in all areas. Therefore, addressing vaccine hesitancy requires territorially adapted strategies that take regional and cultural specificities into account to promote greater acceptance of vaccines.

Keywords: Vaccine hesitancy. Vaccine-preventable diseases. Vaccination coverage.

RESUMEN

La baja cobertura en la vacunación, a nivel general, ha causado preocupación en los sistemas sanitarios de todo el mundo debido al riesgo de reaparición de enfermedades que ya han sido eliminadas. Uno de los principales factores que contribuyen a esta baja cobertura es la indecisión para aplicarse las vacunas, definida como el retraso o la negativa a aceptar las vacunas recomendadas, incluso cuando están disponibles. Ante este escenario, el objetivo de este estudio fue analizar la indecisión hacia las vacunas en la Región Metropolitana de la “Baixada Santista” (Región Metropolitana de Santos y municipios vecinos) y su influencia en la vacunación de niños de hasta dos años. Este estudio epidemiológico transversal se realizó mediante una encuesta domiciliaria sobre la cobertura de vacunación infantil (0 a 2 años) en los municipios de Santos, São Vicente, Cubatão, Peruíbe, Itanhãem, Bertioga, Praia Grande, Guarujá y Monganguá. La muestra probabilística incluyó 831 participantes, con un nivel de significación del 5% y una potencia del 80%, y la encuesta tuvo lugar entre noviembre de 2020 y abril de 2022. El análisis utilizó pruebas de asociación y una escala de Likert para medir el grado de indecisión sobre la vacuna. Los resultados indican que el 74% de las encuestadas eran madres, la mayoría con estudios secundarios o superiores incompletos (54%), con edades comprendidas entre los 30 y los 39 años (44,5%) y el 53,5% trabajaba fuera de casa. Los niños eran mayoritariamente blancos (56,2%) y fueron llevados por sus madres a vacunar (77,3%), siendo las Unidades Básicas de Salud (UBS) el principal lugar de vacunación (92,4%). Además, el 16,8% de los encuestados afirmó que la pandemia de Covid-19 había influido en la no aplicación de vacunas. El análisis indicó una asociación significativa ($p<0.05$) entre la indecisión ante las vacunas y las zonas geográficas de la región. La zona Norte mostró el mayor porcentaje de indecisión en aplicación de vacunas, aunque la indecisión fue significativa en todas las zonas. Las pruebas de comparación múltiple de Bonferroni y Kruskal-Wallis revelaron diferencias entre las regiones en cuanto a la indecisión. Basándose en el concepto de vulnerabilidad de Ayres, que considera la interacción entre factores individuales, sociales y programáticos, el estudio pone de relieve que la indecisión ante la vacuna en la región es multifacética. En todos los ámbitos se identificaron factores que encajan en las 5C (confianza, complacencia, conveniencia, cálculo y responsabilidad colectiva). Por lo tanto, la lucha contra la indecisión ante las vacunas debería implicar estrategias adaptadas al territorio, teniendo en cuenta las especificidades regionales y culturales para promover una mayor aceptación de las vacunas.

Palabras clave: Dudas en vacunas. Enfermedades prevenibles mediante vacunación. Cobertura en vacunación.

INTRODUCTION

Vaccination is a preventive intervention supported by extensive scientific evidence, resulting in a significant reduction in morbidity and mortality associated with vaccine-preventable diseases. Early administration of vaccines, usually started at birth and in the first years of life, promotes a more effective and faster immune response.

Although widely recognized as one of the most successful public health interventions, vaccination still faces challenges, with global vaccination coverage falling short of the targets set by the World Health Organization (WHO). It is estimated that if vaccination coverage reached 95% globally, about 1.5 million deaths could be avoided annually (Oliveira, 2021).

In Brazil, vaccination is constitutionally guaranteed as a fundamental right of all citizens (Malavé, 2019). However, the country, like the rest of the world, is dealing with the growing problem of vaccine hesitancy, intensified by the spread of misinformation, especially on digital platforms. This phenomenon requires a multifaceted approach, which includes coordinated actions in health communication, education, and community engagement, in order to restore confidence in vaccines and create an environment conducive to vaccine adherence.

The WHO, through the Working Group on Vaccine Hesitancy (SAGE), defines vaccine hesitancy as the delay or refusal to accept available vaccines, a dynamic phenomenon influenced by the sociocultural context and the specific characteristics of each vaccine (ZHANG et al., 2023). Initially, SAGE identified three main factors influencing this hesitancy: complacency, convenience, and trust. Complacency refers to the underestimation of the risks of vaccine-preventable diseases; convenience involves barriers to physical, financial, or geographic access to vaccines; and trust is related to doubts about the effectiveness of vaccines and the credibility of health systems.

Vaccine hesitancy has become even more relevant in the post-COVID-19 pandemic context, when there has been a sharp decrease in vaccination coverage of previously controlled diseases. The proliferation of *fake news* and the lack of awareness campaigns on childhood vaccination contributed to this reduction, negatively impacting vaccine adherence (Troiano and Nardi, 2021).

This phenomenon is not restricted to a specific demographic group, but is influenced by a confluence of sociocultural and economic factors that shape perceptions about the necessity, safety, and efficacy of vaccines. Macdonald et al. (2015) suggest that the phenomenon should be addressed through communication and education strategies that consider regional and cultural particularities.

In the face of these challenges, understanding the multifactoriness that leads to vaccine hesitancy is essential for the formulation of more effective and equitable public policies. In this context, the concept of vulnerability proposed by Ayres (2003) becomes fundamental, as it offers an integrated perspective to analyze the interaction between individual, social, and programmatic factors that contribute to vaccine hesitancy.

By considering individual vulnerabilities, such as lack of knowledge, cultural factors, and distrust in vaccines, and programmatic vulnerabilities, such as failures in health services and the spread of *fake news*, it becomes possible to develop interventions that are more adapted to local realities.

In this sense, knowing and addressing these vulnerabilities, as Ayres (2003) proposes, is essential to ensure equity in access to vaccines, and preventing the reemergence of vaccine-preventable diseases. By recognizing that vaccine hesitancy is shaped by the complexity of social and institutional vulnerabilities, public policies can be more effective by considering these multiple factors, expanding collective protection and strengthening confidence in immunization.

The survey was developed in the Metropolitan Region of Baixada Santista RMBS, which, like other regions of Brazil, has been facing a drop in vaccination coverage rates. This area, composed of a diverse population with varied socioeconomic realities, clearly reflects the challenges faced at the national level, such as the difficulty in accessing health services and the influence of social networks in the dissemination of incorrect information about vaccines. The choice of this region is justified by the need to analyze these specific factors in an urban and peri-urban population, seeking to understand how local dynamics impact vaccination adherence and the implementation of public health policies. In the case of the RMBS, understanding these factors can provide subsidies for the development of specific measures that respond to the needs of the local population and be a model for other regions.

Therefore, the objective of this study was to analyze the factors of vaccine hesitancy in children up to two years of age living in the Metropolitan Region of Baixada Santista.

METHODOLOGY

This study was approved by the Research Ethics Committee of the Catholic University of Santos under CAAE No. 16315119.3.0000.5536 and funded by the Bill and Melinda Gates Foundation and CNPq.

This cross-sectional epidemiological study was carried out through a household survey, based on a random probabilistic population sample. The survey adopted methods of

survey and analysis of social, economic and demographic data, characterized by direct interaction with the participants. This proximity to the interviewees not only facilitated the collection of quantitative data, but also allowed a deeper understanding of the social reality, making it possible to identify the factors related to vaccine hesitancy as a socially constructed phenomenon.

The study area covers the Metropolitan Region of Baixada Santista (RMBS), composed of nine municipalities in the state of São Paulo, with a territorial extension of 2,420 km². The municipalities included in the survey were: Peruíbe, Itanhaém, Mongaguá, Praia Grande, Cubatão, São Vicente, Santos, Guarujá and Bertioga. For sampling purposes, each municipality was considered a stratum, contributing proportionally to the composition of the final sample.

The probabilistic sample was calculated based on the lowest average vaccination coverage of the vaccines recommended for children aged 0 to 2 years in the RMBS, which was 59%. A significance level of 5% and a statistical power of 80% were used, with a confidence interval of 95% and a delta of 5%, allowing vaccination coverage to vary between 54% and 64%. Considering an estimated loss rate of 10%, the minimum sample size was calculated at 831 participants. After calculating the sample size for each municipality, the random sampling technique was applied, in which the children were selected by random draw, according to the method described by Altman (1995). The sampling plan followed the methodology recommended by the World Health Organization for conducting cluster vaccination coverage surveys. A street draw was carried out in the municipalities and the search for children born in 2018.

To select the residences to be included in the research, a random sampling approach was used. Initially, the streets in each city were drawn. This process ensured that all streets were equally likely to be included in the sample. In this way, we sought to maximize the generalization of the results and make the conclusions more reliable, reflecting the diversity of the population surveyed. All information collected was treated strictly confidentially and used only for the specific purposes of this research. In addition, all participants were informed about the objectives of the study and had the opportunity to voluntarily consent to their participation.

Personal interviews were conducted with a structured questionnaire applied to 831 mothers or guardians of children born in 2018 in the Metropolitan Region of Baixada Santista who were aged between 18 and 30 months on July 1, 2020. The survey took place from November 2020 to April 2022. It is noteworthy that our study uses self-reported information.

For analytical purposes, the municipalities of the RMBS were grouped into three territories: (1) South Region, composed of the municipalities of Mongaguá, Itanhaém and Peruíbe, characterized by their tourist and coastal activities; (2) North Region, composed of

Bertioga, a seaside resort municipality with low verticalization of residences, which was emancipated as a municipality in 1991; and (3) Central Region, composed of the municipalities of Praia Grande, São Vicente, Guarujá, Cubatão. The city of Santos was analyzed separately, due to its economic importance, standing out for being home to the largest port in Latin America and for having a high density of jobs, which generates intense daily commuting and conurbation with neighboring municipalities (IBGE, 2021).

The questionnaire used in the research was standardized and structured in five sections, in order to ensure the uniformity of the data collected among the participants. Demographic and socioeconomic information, child characteristics, vaccination booklet, and a questionnaire on vaccine hesitancy were obtained using the 5C model (Trust, compliance and convenience, calculation, collective responsibility). This rigorous methodological approach ensured the collection of consistent and comprehensive data, which is essential for understanding the factors influencing vaccine hesitancy in the region.

The 5C hesitancy model has the following domains: Complacency: low perception of the risks of vaccine-preventable diseases; Convenience: factors related to physical availability, costs, geographic accessibility; Trust: confidence in the efficiency of vaccines and the system that administers them; Calculation: involvement of individuals through research on information on the subject; Collective Responsibility: the intention to protect other individuals through one's own vaccination.

Descriptive analysis of all variables (weighted frequencies) and Pearson's chi-square test were performed to verify a univariate association between the independent variables and the outcome ($p < 0.05$)

The transformation of qualitative variables into dichotomous variables and the application of the Chi-square test (χ^2) made it possible to infer about vaccine hesitancy in the North, Central, South and Santos Regions.

For a better analysis of the results, a quantitative approach was used for the questionnaire and used a 5-point Likert scale to measure the degree of agreement of the subjects who answered the questionnaires. The Likert scale allows researchers to capture the intensity of participants' responses using a series of graded response options.

This process aims at the quantification and statistical analysis of the answers collected from affirmative questions related to the study theme. In this study, respondents are asked to indicate their opinion in relation to each item described as "strongly disagree", "disagree", "neither agree nor disagree", "agree" and "strongly agree".

The classification in relation to the level of hesitation regarding the questions evaluated was carried out by obtaining the score attributed to the answers related to the

frequency of the events. To produce an overall score, we assign 1 to strongly disagree; 2 to disagree; 3 to neither agree nor disagree; 4 to agree; 5 to strongly agree

The performance scores were recorded and analyzed using an ANOVA test, where the calculated value of F was compared to the critical value of the distribution F, corresponding to a significance level of 5% ($\alpha = 0.05$). To verify the association between nominal qualitative variables, the Chi-square test (χ^2) or Fisher's Exact Test was performed. The Kruskal-Wallis test was used to compare regions when using the Likert scale and the Bonferroni test to minimize type 1 error, both maintaining $\alpha = 0.05$.

Logistic regression analysis was performed to identify the factors that led to vaccine hesitancy. All point estimates and their respective confidence intervals were calculated using the statistical software SPSS 24.0 for Windows (*Statistical Package for the Social Sciences*).

RESULTS

The results of the survey reveal that 44.5% of the mothers interviewed are in the age group of 30 to 39 years, with a higher concentration of this age group in the southern region of the Baixada Santista. The predominance of married and formally employed women was observed, although there is a significant proportion of single women who assume responsibility for the household (Table 1).

Table 1. Descriptive analysis of data on children and the habit of vaccinating in the Metropolitan Region of Santos. RMBS, 2023.

	Region South Region	Santos-Polo	Central Region	North Region	Level of significance
Mother's education					**<0.001**
illiterate/ Incomplete Elementary School	4(1,6)	1(,0,5)	0(0,0)	2(1,0)	
Complete Elementary / Incomplete Elementary	21(8,4)	12(5,8)	4(2,4)	28(13,5)	
Elementary 2 Complete and Incomplete High School	56(22,4)	40(19,4)	23(13,8)	26 (25,5)	
Complete High School/ Incomplete Higher Education	147(58,8)	109(52,9)	91(54,5)	102(49,0)	
Complete Higher Education	22(8,8)	44(21,4)	49(29,3)	23(11,1)	
Mother's age					**<0.001**
16 TO 19	8(3,2)	4(1,9)	1(0,6)	11(5,3)	
20 TO 29	107(42,8)	81(39,3)	64(38,3)	91(43,8)	
30 A 39	114(45,6)	89(43,2)	82(49,1)	85(40,8)	
40 A 49	20(8,0)	30(14,6)	-10	19(9,2)	
50 TO 59	1(0,4)	0(0,0)	1(0,6)	0(0,0)	
60 more	0(0,0)	0(0,0)	0(0,0)	1(0,5)	
Age ignored	0(0,0)	2(1,0)	3(1,8)	1(0,5)	

Mother's marital status	South Region	Santos-Polo	Central Region	North Region	<0.001
S.olteiral	0(0,0)	0(0,0)	1(0,6)	0(0,0)	
Married woman	133(53,2)	99(48,1)	86(51,5)	107(51,4)	
Divorced	1(0,4)	2(1,0)	7(4,2)	1(0,5)	
Separate	1(0,4)	1(0,5)	2(1,2)	3(1,4)	
Single	111(44,4)	102(49,5)	70(41,9)	97(46,6)	
Widow	4(1,6)	2(1,0)	1(0,6)	0(0,0)	
Type of house Region					**<0.001**
Rented	58(23,2)	76(36,9)	52(31,1)	62(29,8)	
Homemade / Loaned	24(9,6)	11(5,3)	15(13,0)	27(13,0)	
CDHU / own / my house my life / village	153(61,2)	115(55,8)	95(51,9)	108(51,9	
invaded / mangrove / occupation / land	1(0,4)	1(0,5)	1(0,5)	9(4,3)	
No information	14(5,6)	3(1,5)	4(2,4)	2(1,0)	
Does the mother work?					**0,198**
yes	122(48,8)	108(52,4)	94(56,3)	121(58,2)	
No	128(51,2)	98(47,6)	73(43,7)	87(41,8)	
Does mother receive a family grant?					**0,001**
Yes	82(32,8)	47(22,8)	23(13,8)	64(30,8)	
No	163(65,2)	152(73,8)	142(85,0)	142(68,3)	
Not informed	5(2,0)	7(3,4)	2(1,2)	2(1,0)	

Regarding education, most mothers have completed high school, especially in the South Region. Regarding family income, the data indicate that the predominant range varies between R$ 1,101.00 and R$ 2,200.00, with most families having only one economically active member. The family configuration is generally composed of a single child, and the responsibility for vaccinating children falls mostly on the mothers (Table 1).

The research also investigated the participation of families in the Bolsa Família program, a Brazilian government initiative for direct income transfer aimed at families in situations of social vulnerability (table 1). During the data collection period, the requirements for granting the benefit included prenatal exams and keeping the vaccination card up to date for children aged 0 to 6 years. The analysis of the data obtained suggests that the obligation to update the vaccination card to receive the benefits acts as a relevant factor to stimulate vaccine adherence. These results corroborate the hypothesis that social programs, by linking access to benefits to compliance with public health requirements, play an important role in promoting vaccination coverage, especially among vulnerable populations.

Regarding the levels of vaccine hesitancy, the data indicate that, although the prevalence of low hesitancy is predominant in all the regions analyzed, the rates of moderate vaccine hesitancy are significant in all areas, with special emphasis on the Pole Region, where 22.33% of the participants had vaccine hesitancy at the medium level (Table 2). These findings are worrisome because, even though the majority of the population demonstrates adherence to vaccination, the presence of a considerable portion with

moderate vaccine hesitancy can compromise the achievement of the vaccination coverage goals established by health authorities. Thus, a detailed understanding of the factors influencing these different levels of hesitancy is crucial for the formulation of targeted and effective interventions, adjusted to the sociocultural and economic particularities of each region.

Table 2. Classification in Levels of Vaccine Hesitancy in the cities of the Metropolitan Region of Baixada Santista

		South Region	Santos-Polo	Central Region	North Region
category	scale	%	%	%	%
Very high hesitation	less than 20	0	0	0	0
High hesitation	20 to 28	0	0,49	0	0
Medium hesitation	29 to 37	9,6	22,33	14,97	17,79
Low Hesitation	38 to 46	89,6	73,3	70,66	78,85
Very low hesitation	Over 46	0,8	3,88	14,37	3,36

The evidence, obtained using the chi-square test with a significance level of 0.05, indicates significant differences between regions with regard to vaccine hesitancy (Table 3). The city of Santos, considered a regional hub, stood out for the predominance of responses that point to hesitancy, especially in aspects involving the perception of the importance of vaccination for child health and the belief that "my child does not need vaccines for diseases that are currently rare".

In the North Region, the greatest diversity of responses related to vaccine hesitancy was verified. The main factors of hesitancy in this area are associated with the understanding of how vaccines work, the relevance of herd immunity, confidence in the efficiency of the National Vaccination System, the coverage provided by immunobiologicals, and resistance to the guidance of health professionals who provide care to children.

These results underscore the need to develop region-specific strategies to address the multiple dimensions of vaccine hesitancy, taking into account regional particularities and the main barriers identified.

Table 3 - Descriptive analysis of data on vaccine hesitancy in the Metropolitan Region of Santos. RMBS, 2023

	South Region	Santos-Polo	Central Region	North Region	Chi-square test
No. (%)					
Vaccines are important for my child's health					
No Hesitation	229 (91,6)	150(72,8)	132(79,0)	157(75,5)	<0.001
Hesitation	21(8,4)	56(27,2)	35(21,0)	51(24,5)	
Do vaccines work?					
No Hesitation	217(86,8)	144(69,9)	131(78,4)	144(69,2)	<0.001
Hesitation	33(13,2)	62(30,1)	36(21,6)	64(30,8)	
Vaccinating my child is important for the health of other children in my neighborhood					
No Hesitation	215(86,0)	147(71,4)	127(76,0)	147(70,7)	<0.001

Hesitation	35(14,0)	59(28,6)	40(24,0)	61(29,3)	
All childhood vaccines that are provided by the government are beneficial					
No Hesitation	196(78,4)	141(68,4)	120(71,9)	135(65,2)	0,013
Hesitation	54(21,6)	65(31,6)	47(28,1)	72(34,8)	
Vaccinating is a way to protect my child from diseases					
No Hesitation	204(81,6)	146(70,9)	130(77,8)	146(70,2)	
Hesitation	46(18,4)	60(29,1)	37(22,2)	62(29,8)	0,012
I usually follow the vaccination guidelines that the health professionals who care for my child recommend					
No Hesitation	192(76,8)	144(69,9)	124(74,3)	132(63,5)	0,013
Hesitation	58(23,2)	62(30,1)	43(25,7)	76(36,5)	
My child does not need vaccines for diseases that are not currently common					
No Hesitation	174(69,6)	114(55,3)	124(74,3)	151(72,6)	<0.001
Hesitation	76(30,4)	92(44,7)	43(25,7)	57(27,4)	

Table 4 presents the descriptive analysis of the levels of vaccine hesitancy in the different regions of the study. The Kruskal-Wallis test revealed a statistically significant difference between the regions (p = 0.003). Through the Bonferroni multiple comparison test, it was found that the South Region has a significantly higher level of vaccine hesitancy, as assessed by the Likert scale, when compared to the North Region (p = 0.017). On the other hand, the Polo Region had the lowest average vaccine hesitancy score in relation to the other regions, indicating a lower propensity for hesitancy.

These findings point to significant regional variations in attitudes towards vaccination, with the South Region demonstrating greater resistance to immunization, while the Polo Region stands out for greater adherence to vaccination practices. This distinction reinforces the importance of developing intervention strategies adjusted to regional specificities, aiming to increase vaccination coverage and reduce hesitancy in more vulnerable areas.

Table 4- Descriptive analysis of the level of vaccine hesitancy by study region, RMBS, 2023.

	Average	Median	Standard deviation	Minimum	Maximum
South Region	41,84	42,00	3,23	32,00	50,00
Polo-Santos	40,75	42,00	4,19	26,00	50,00
Central Region	42,34	42,00	4,26	32,00	50,00
North Region	41,17	42,00	3,78	30,00	50,00

Table 5 presents the logistic regression analysis, carried out with methodological rigor, to identify the risk factors associated with vaccine hesitancy. The results reveal that, compared to the South Region, residents of the Santos-Polo Region are 2.78 times more likely to be vaccine hesitant, while residents of the North Region are 2.04 times more likely to demonstrate vaccine hesitancy. The other variables included in the model did not present statistical significance.

These results indicate that the place of residence is an important determinant in the predisposition to vaccine hesitancy, pointing to the need for specific regional interventions that consider the particularities of the territories. The implementation of strategies directed to the

specific characteristics of each region can be essential for the promotion of greater vaccination adherence and, consequently, for the improvement of vaccination coverage rates.

Table 5. Logistic regression analysis on vaccine hesitancy

	OR	95%CI	
Region			
South Region	1		
Santos-Polo	2,78	1,64	4,74
Central Region	1,66	0,91	3,02
North Region	2,04	1,18	3,53

The phenomenon of vaccine hesitancy is characterized by its multifactorial nature, driven by a series of interrelated factors. In the survey, several causes were identified that contribute to this behavior, such as concerns about the safety of vaccines and fear of possible side effects. Personal beliefs and religious influences also play an important role in the decision to vaccinate or not.

In addition, a distrust of health authorities was observed, often exacerbated by the perception of inadequate treatment by the professionals responsible for administering the vaccines. Situations such as harsh responses or lack of welcome in the vaccination rooms were reported as aggravating factors of this distrust. Misinformation, or even the absence of adequate information provided by the attendants of the Basic Health Units (UBS), contributed significantly to increasing uncertainty regarding vaccination.

Another relevant factor identified was the influence of anti-vaccination movements, which take advantage of the dissemination of incorrect information to fuel resistance to immunization. This set of factors highlights the complexity of the vaccine hesitancy phenomenon, reinforcing the need for integrated and multisectoral strategies to effectively address the problem and promote greater adherence to vaccination campaigns.

DISCUSSION

Vaccine hesitancy is influenced by a series of factors that go beyond individual issues, encompassing social, cultural, economic, and, especially, organizational dimensions, with an emphasis on the conditions and practices of health services. In this context, according to the concept of vulnerability proposed by Ayres (20023), it is possible to identify both individual and programmatic vulnerabilities that affect vaccination adherence. Individual vulnerabilities relate to socioeconomic, cultural, and information access factors, which shape risk perception and trust in vaccines.

Programmatic vulnerabilities, in turn, refer directly to the organizational factors of health services, such as inadequate management, lack of coordination between health

units, scarcity of human and material resources, and the absence of flexible care strategies, such as extended hours and decentralized vaccination points. In addition, misinformation or unwelcoming care by health professionals can reinforce the feeling of insecurity and distrust in relation to vaccines. These structural limitations compromise the effectiveness of vaccination campaigns and hinder equitable access to immunobiologicals, exacerbating inequalities and increasing programmatic vulnerabilities. Thus, vaccine hesitancy emerges as a complex phenomenon, determined by the interaction between these multiple organizational and individual factors.

The phenomenon of vaccine hesitancy, as demonstrated in the study conducted at RMBS, is driven by a number of factors, including concerns about vaccine safety, misinformation, personal beliefs, distrust of health authorities, and the influence of anti-vaccination movements. These factors are directly connected to the individual vulnerabilities described by Ayres, which reflect socioeconomic, cultural, and access to information conditions. Individual vulnerability is manifested, for example, in the different incidences of hesitancy observed as a function of territory and level of education, as pointed out by Brown (2019), who reports vaccine hesitancy in several vaccines on the national calendar, affecting populations unequally.

When analyzing the relationship between vaccine hesitancy and schooling, the study indicates that mothers with complete primary education have greater hesitancy than those with high school or higher education. This inequality can be explained by socioeconomic vulnerabilities, evidenced by greater hesitation among mothers who are beneficiaries of the Bolsa Família program. These findings reinforce Ayres' idea that vulnerability is multidimensional, influenced not only by individual factors, but also by social position and lack of access to resources. Bertoncello (2020) and Nobre (2022) corroborate that economic difficulties and low education are strongly associated with vaccine hesitancy, contributing to the exclusion of these families from health services.

These individual vulnerabilities are amplified by programmatic vulnerabilities, such as the inadequacy of health services. The management and organization of the Basic Health Units (UBS), for example, are a reflection of these structural limitations. The lack of flexibility in service hours and the misinformation provided by health professionals in the UBS reinforce the insecurity and distrust in relation to vaccines. Bezerra (2018).

In the study, the mothers interviewed reported that the incompatibility between the opening hours of the UBS and their working hours was one of the main reasons for the delay in the immunization of their children. The study reflects this reality, as many guardians reported not being able to vaccinate their children due to the incompatibility of the

schedules of the vaccination rooms, a problem that proved to be more prevalent in the southern region of the country. This type of structural barrier highlights the importance of adapting health services

In this sense, the creation of flexible strategies, such as extending hours and carrying out vaccination campaigns in strategic locations, can reduce programmatic vulnerabilities by facilitating access to immunization services for the most vulnerable populations. These initiatives are crucial to promote more equitable vaccination coverage and reduce health inequalities, according to Ayres' view, which reinforces the need to consider both individual and programmatic vulnerabilities in health policy planning.

In addition, Silveira et al. (2020) point out that the occasional shortage of vaccines also contributes to vaccine hesitancy. The limitation of health services, together with the inadequate location of vaccination points, amplifies programmatic vulnerabilities and aggravates resistance to immunization. To combat this problem, it is essential to implement strategies that ensure equitable access, particularly for the most vulnerable populations.

Another factor that enhances individual and programmatic vulnerabilities is the spread of *Fake News*, which associates vaccines with unfounded risks. This phenomenon, as identified in the study, fuels vaccine hesitancy through social networks and influence groups, such as family members and religious leaders. The study found, through direct questions and dialogues in personal interviews, that the dissemination of negative information about vaccines occurs predominantly through messages on applications such as *WhatsApp* and through informal conversations with friends and family. In addition, religious factors were also mentioned as reasons for delaying or refusing vaccination, indicating that personal beliefs play a significant role in vaccine hesitancy.

Misinformation becomes a vulnerability that directly affects confidence in vaccines, especially among populations with less access to qualified information. This scenario reinforces the need for actions that address misinformation through health education and clear and accessible communication, reducing both individual and programmatic vulnerabilities.

Narges (2020) highlights the importance of neutralizing *fake news, analyzing the reasons underlying vaccine hesitancy. In the study, when asked whether the new vaccines posed more risks than the old ones, a significant percentage of respondents fully or partially agreed, which suggests that this perception may have been reinforced by the spread of dubious information and the amplified fear during the pandemic. Distrust, fueled by this fake news*, influences behaviors, showing that combating vaccine hesitancy is a complex

process, involving multifaceted factors that align with the 5Cs model (trust, complacency, convenience, calculation, and context).

By relating Ayres' (2003) vulnerabilities to these factors, the study reveals the complexity of the phenomenon of vaccine hesitancy and the need for approaches that integrate social, economic, cultural, and organizational dimensions. By recognizing these vulnerabilities, it becomes possible to develop more effective and equitable strategies to increase vaccination uptake and improve public health.

Ayres (2003) describes vulnerability as a construction that involves both the subject and the context, and in this sense, vaccine hesitancy is configured as a reflection of this interaction. Overcoming these vulnerabilities requires integrated approaches that include both the improvement of health services and educational actions aimed at raising awareness and combating misinformation. . Ayres' concept of vulnerability is central to understanding the multiple factors that influence vaccine hesitancy.

Vaccine hesitancy is, therefore, a reflection of the interaction between individual vulnerabilities (lack of information and personal beliefs) and programmatic vulnerabilities (structural failures and access to health services). According to Ayres, vulnerability involves both the subject and the context, and to combat vaccine hesitancy, it is necessary to address these factors in an integrated way. Overcoming these vulnerabilities requires actions that include improving health services and combating misinformation through education and awareness.

In this sense, Santos Júnior et al. (2022) highlight that, for the success of educational strategies aimed at vaccination, it is essential to identify the specific demands of populations and adapt intervention approaches. In this way, it is possible to develop actions that effectively reduce barriers to access and minimize delays and vaccine hesitancy.

Another factor that aggravates vaccine hesitancy is the decrease in the perception of risk in relation to diseases that have been eradicated or controlled, as pointed out by Brown (2019). In the collective imagination, the severity of these diseases is no longer recognized, which leads many to question the real need to get vaccinated. This complacency, as described by Sato (2023), is the result of a low perception of the danger that these diseases still pose, contributing to the increase in vaccine hesitancy.

In this sense, this scenario reinforces the urgency of educational campaigns that clarify the population about the continuous benefits of vaccination and the importance of maintaining high vaccination coverage rates to prevent the resurgence of these diseases. The study conducted in the RMBS confirms this trend in all regions analyzed, highlighting the importance of reinforcing awareness of the ongoing benefits of vaccination.

Lack of vaccination puts society at collective risk, as unvaccinated individuals can facilitate the spread of disease. The study found that many respondents do not understand that the lack of immunization of their children makes them potential spreaders of vaccine-preventable diseases.

In this context, it is essential to discuss the legal and social implications of not vaccinating children and adolescents. Refusal to be immunized, in addition to being a violation of legal regulations in many countries, including Brazil, exposes these individuals to avoidable health risks and turns them into potential disseminators of contagious diseases in society. The decision to vaccinate goes beyond an individual right; it is intrinsically linked to the principles of solidarity, collective responsibility, and social justice, as Cardin and Nery (2019) argue.

In the study's findings, a significant portion of respondents demonstrated that they did not adequately understand the relationship between non-vaccination and its impacts, ignoring that refusing to vaccinate their children not only exposes them to significant risks, but also turns them into potential vectors for the transmission of vaccine-preventable diseases (Bertoncello, 2020). This lack of knowledge reinforces the urgent need for robust educational campaigns that emphasize, in a clear and accessible way, both the individual benefits of vaccination and its essential role in protecting public health.

In this context, the active participation of society and the community is essential to promote positive information about vaccination. Lessa (2015) highlights that community engagement strengthens collective protection, and the role of the community as a space for the exchange of knowledge is fundamental to combat vaccine hesitancy. Katzman (2021) points out that community engagement should go beyond the simple dissemination of information, promoting active and reflective dialogue, with collaborative approaches, and effective communication can strengthen trust in vaccines and improve vaccination coverage, combating the spread of misinformation and increasing collective protection.

In this sense, regional and cultural particularities must be considered in the training of health agents, as highlighted by Kirksey, Sorour and Modlin (2021). They underline the importance of tailoring vaccination messaging to local specificities to adequately address population concerns. In the study, 23.8% of respondents reported receiving negative information about vaccines mainly through social networks and applications such as WhatsApp.

The study revealed regional differences in vaccine hesitancy, with different prevalences in the North and South regions, associated with socioeconomic and cultural

factors. Logistic regression analysis showed that the characteristics of the territory influence these disparities, evidencing the need for regional control strategies.

From this perspective, Ayres' concept of vulnerability is fundamental to understanding the complexities of vaccine hesitancy. Individual vulnerabilities, such as low education and lack of knowledge, combine with programmatic vulnerabilities, such as the inadequacy of health services, to perpetuate vaccine hesitancy. The implementation of public policies that ensure equitable access, along with improved communication between health professionals and the population, is essential to reduce these vulnerabilities and increase adherence to immunization campaigns, promoting more effective and fair vaccination coverage.

CONCLUSION

The study investigated vaccine hesitancy among mothers aged 30 to 39 years, with children born in 2018, in the Metropolitan Region of Baixada Santista, identifying a series of interrelated factors that amplify vulnerabilities, according to Ayres' concept. Socioeconomic, behavioral, and organizational aspects were the main contributors to this phenomenon. The results indicate that low schooling, especially among mothers with complete primary education, and the receipt of benefits such as Bolsa Família, are strongly associated with distrust in vaccines and health authorities. In addition, the spread of misinformation on social networks, added to personal beliefs and the influence of anti-vaccination movements, emerge as critical elements in vaccine hesitancy.

The research highlights the importance of adopting culturally sensitive approaches, adjusted to regional particularities, to address vaccine hesitancy effectively. Overcoming this challenge requires a coordinated, multidimensional response, involving collaboration between governments, health workers, and civil society. Investment in evidence-based educational strategies, combined with clear communication and active involvement of communities, is essential to strengthen vaccine adherence and rebuild trust in the health system, thus ensuring collective protection.

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