Cogitare Enfermagem

ORIGINAL ARTICLE

RISK CLASSIFICATION OF VACCINE-PREVENTABLE DISEASES AND THEIR SPATIAL DISTRIBUTION*

Jéssica Oliveira Da Cunha[1], Lays Hevércia Silveira De Farias[2], José Augusto Passos Góes[3], Mateus Meneses Bispo[4], Thaynara Silva Dos Anjos[5], Glebson Moura Silva[6], Allan Dantas Dos Santos[7]

ABSTRACT
Objective: to classify the risk of vaccine-preventable diseases and their spatial distribution in municipalities of Sergipe.
Method: an epidemiological study, using secondary information bases from the Information System of the National Immunization Program in 2017, regarding the vaccination schedule of children up to two years of age, in the 75 municipalities of Sergipe. For data statistical analysis, the Epi Info program, version 7.2.2.6 and QGIS were used to prepare the map.
Results: only 46.7% of the municipalities in Sergipe had adequate vaccination coverage for BCG. In the entire state, the vaccines analyzed showed a very low degree of homogeneity. The measles, mumps and rubella had the highest dropout rate of 73 (97.3%).
Conclusion: a high risk of developing vaccine-preventable diseases was identified in most municipalities in Sergipe. Cumulative efforts are needed by SUS users, health professionals and managers to ensure success and good adherence to immunization activities.

DESCRIPTORS: Immunization; Vaccination Coverage; Indicators of Health Services; Immunization Programs; Monitoring.

[1]Nurse. Master in Nursing. Resident in Family Health. Federal University of Sergipe. Campo do Brito, SE, Brazil.
[2]Nurse. Master´s student in Nursing. Fiocruz. Recife, PE, Brazil.
[3]Nurse. Master´s student in Nursing / Graduate Program in Nursing. Federal University of Sergipe. Campo do Brito, SE, Brazil.
[4]Nurse at Brazilian hospital services company (EBSERH) Aracaju/Se, Brazil. Aracaju, SE, Brasil.
[5]Nurse. Master in Nursing. Federal University of Sergipe. Itabaiana, SE, Brazil.
[6]Nurse. Doctor of education . Professor, Nursing Department, Federal University of Sergipe/ Campus Lagarto. Aracaju/SE, Brazil.
[7]Nurse. PhD in Health Sciences. Professor, Nursing Department, Federal University of Sergipe/ Campus Lagarto. Aracaju/ SE, Brazil.

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CLASSIFICAÇÃO DE RISCO DE DOENÇAS IMUNOPREVENÍVEIS E SUA DISTRIBUIÇÃO ESPACIAL

RESUMO

Objetivo: classificar o risco das doenças imunopreveníveis e sua distribuição espacial nos municípios sergipanos.

Método: estudo epidemiológico, com utilização de bases de informaçes secundárias pelo Sistema de Informações do Programa Nacional de Imunizações no ano de 2017, referente ao esquema vacinal até o segundo ano de idade, nos 75 municípios sergipanos. Para análise estatística dos dados, utilizou-se o programa Epi Info versão 7.2.2.6 e QGIS para elaboração do mapa.

Resultados: 46,7% dos municípios sergipanos apresentaram cobertura vacinal adequada para BCG. Em todo estado, os imunobiológicos analisados apresentaram grau de homogeneidade baixo. A vacina Tríplice viral teve a mais elevada taxa de abandono 73 (97,3%).

Conclusão: identificou-se quadro de alto risco de desenvolvimento de doenças preveníveis por vacinas na maioria dos municípios sergipanos. Esforços cumulativos são necessários por parte dos usuários, profissionais de saúde e gestores do Sistema Único de Saúde para assegurar êxito e boa adesão às atividades de imunização.

DESCRITORES: Imunização; Cobertura Vacinal; Indicadores de Serviços; Programas de Imunização; Monitoramento.

CLASIFICACIÓN DE RIESGO DE ENFERMEDADES INMUNOPREVENIBLES Y SU DISTRIBUCIÓN ESPACIAL

RESUMEN:

Objetivo: Clasificar el riesgo de las enfermedades inmunoprevenibles y su distribución espacial en los municipios de Sergipe, Brasil.

Método: Estudio epidemiológico, utilizando bases de datos secundarias, por Sistema de Información del Programa Nacional de Inmunizaciones en 2017, respecto del esquema de vacunación infantil hasta los dos años en los 75 municipios de Sergipe. Se utilizó Epi Info versión 7.2.2.6 para análisis estadístico y QGIS para elaboración del mapa.

Resultados: Solamente el 46,7% de los municipios de Sergipe mostraron cobertura vacunal adecuada para BCG. En todo el estado, los inmunobiológicos analizados demostraron muy bajo grado de homogeneidad. La vacuna Triple Viral tuvo la más alta tasa de abandono: 73 (97,3%).

Conclusión: Se identificó marco de alto riesgo para desarrollo de enfermedades prevenibles por vacunación en la mayoría de los municipios de Sergipe. Se requieren esfuerzos acumulativos para asegurar éxito y adhesión a las actividades de inmunización.

DESCRIPTORES: Inmunización; Cobertura de Vacunación; Indicadores de Servicios; Programas de Inmunización; Monitoreo.

Jéssica Oliveira Da Cunha | Lays Hevércia Silveira De Farias | José Augusto Passos Góes | Mateus Meneses Bispo | Thaynara Silva Dos Anjos | Glebson Moura Silva | Allan Dantas Dos Santos

INTRODUCTION

Vaccination has greatly contributed to the prevention, reduction and control of the spread of various infectious and preventable diseases, avoiding more than two million deaths per year, thus, it is considered an effective strategy and action besides being highly cost-effective concerning curative actions[1].

Immunization activities in Brazil are coordinated by the National Immunization Program (PNI), which is very successful in the country[2]. However, despite advances in vaccination, immunization uptake varies widely between countries and their regions, with divergent and heterogeneous degrees of vaccine coverage[3].

Also, the inequality in the uptake of children who need to be vaccinated routinely can contribute to the accumulation of susceptible individuals in the regions[4,5] and, consequently, to the continuity of the occurrence, resurgence and spread of some vaccine-preventable diseases[6].

It is highly recommended that the vaccination schedule is followed and the delay is banned to positively impact the health of every child, so the recommended immunization schedule is designed to protect from the beginning of life when they are most susceptible and before they are exposed to potentially fatal diseases[1], however, the delay and incompleteness of routine vaccinations are very frequent and have been reported worldwide[7].

Besides, 24 million children born each year do not receive adequate immunization during their first year of life for several reasons that contribute to the reduction of childhood immunization and that increase the risk of serious diseases to re-emerge, which are elucidated in a study carried out in the state of São Paulo through monitoring in Brazilian municipalities, among them stands out the population's misleading perception, the ignorance of the immunization agents that are part of the vaccination routine, the fear of vaccines causing harmful events to the body, the fear of multiple doses causing complications, besides the lack of time to go to the place of vaccination[8,9].

It is worth noting that the indicators for evaluating vaccination performance, such as vaccination coverage (VC), vaccination coverage homogeneity (VCH) and dropout proportion (DP), play an important role in showing the quality of care provided by services; the VC indicator, considered a key item in the performance of the systematized immunization process[10] can support the monitoring of the implementation of national and regional immunization policies, as well as inform about the impact of interventions aimed at increasing the population's adherence to vaccines[11].

Given the above, the objective of this study is to classify the risk of vaccine-preventable diseases and their spatial distribution in municipalities of Sergipe.

METHOD

Epidemiological, descriptive research, using information from secondary bases such as the Information System of the National Immunization Program (SI-PNI) on the coverage of ten vaccines included in the vaccination schedule of children under the two years of age in the public health system administered in 2017, residing in municipalities of Sergipe.

The vaccines used in the study were: (a) BCG- Bacillus Calmette and Guérin; (b) Hep B- hepatitis B; (c) Hep A- hepatitis A, (d) meningococcal C conjugate; (e) pentavalent-diphtheria, tetanus, pertussis, hepatitis B and Haemophilus influenza b; (f) PCV10- 10-valent pneumococcal conjugate (g) inactivated poliovirus (IPV)/attenuated oral poliovirus (OPV)

(poliomyelitis); (h) MMR - measles, mumps and rubella; (i) MMRV- measles, mumps, rubella and attenuated varicella; and (j) RV- human rotavirus. Although yellow fever (YF) vaccine is included in the national infant vaccination schedule at 9 months of age, this was not considered for analysis in this study because it is an area not recommended for the administration of this vaccine.

To check the vaccination situation, the indicators of vaccination coverage (VC) and homogeneity of vaccination coverage among vaccines in the municipality (HCV) were used, both agreed on the Unified health system through two parties: the Organizational Agreement of Public Health Action (COAP) and the Qualification Program of Surveillance Actions in Health (PQAVS). The dropout proportion (DO) indicators were also evaluated, as well as the transmission risk of vaccine-preventable diseases per municipality (TRVPD).

Concerning VC, the Ministry of Health sets the target for each type of vaccines such as 90% for BCG and RV vaccines, 95% for pentavalent, polio, 10-valent pneumococcal conjugate, meningococcal C, MMR, MMRV, Hep B and A[12].

For VC calculations, the total number of doses that complete the schedule of each vaccine was used as a numerator, and for the denominator, the number of live births in the municipality registered in the Live Birth Information System (Sinasc) in 2012[13]. It is noteworthy that this year was used as a reference because it is the last record available.

To carry out the data analysis, two steps were followed, the first by (I) categorizing the indicators of VC, DP and VCH and second by classifying the risk of transmission of vaccine-preventable diseases in the municipalities. The VC receives three classification scores categorized as: low if lower than the recommended goal; adequate when the target is greater than or equal to that recommended at a value less than or equal to 120% and high when it exceeds 120%.

As for the homogeneity of vaccination coverage, COAP determined that the municipality must reach the vaccination goal for 75% or more, while in PQAVS this proportion was established at 100%, these categorizations are established by the Ministry of Health.

VCH comes in three classes: low if less than 75%; adequate for COAP greater than or equal to 75%; and suitable for PQAVS if equal to 100%.

The dropout proportion - was obtained through the Datasus website - calculated only for vaccines that have a multi-dose schedule such as meningococcal C, Pentavalent, PCV-10 polio, MMR and Human Rotavirus, considering the difference between the number of first doses and the number of the last doses of the vaccination schedule, divided by the number of the first doses, multiplying the result by 100, stratifying into three categories: low if less than 5%; average between 5% to 10%; and higher than 10%.

To calculating the TRVPD in the municipalities, the indicators of vaccination coverage, those of vaccination coverage homogeneity between vaccines and the dropout proportion were used. The spatial distribution of the municipalities was stratified into five categories:

a - if it presents a very low risk - the municipality has a VCH = 100%;

b - if low risk - the municipality has VCH≥75% to <100%, besides a suitable VC for polio, MMR, MMRV and pentavalent vaccines;

c - if medium risk – the municipality with VCH ≥75% to <100%, but with vaccination coverage below the target for one or more of polio, MMR, MMRV or pentavalent vaccines;

d - if high risk - the municipality has a VCH<75%;

e - very high risk - with VCH <75% and a high DP (≥10%).

For data analysis, we used the Epi Info 7 program version 7.2.2.6 (Centers for Disease Control and Prevention, Atlanta, USA, 2008) and to elaborate the map, we used QGIS

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version 2.18.13. The cartographic base used was obtained by IBGE (2010) at a scale of 1 2,000.

Since the study is performed only with secondary data, available in the public domain, without identifying individuals, approval by the Research Ethics Committee is exempted, however, the study protects all ethical precepts in line with the considerations provided for in the Resolution of the National Health Council (CNS) No. 466, of December 12th, 2012[14].

RESULTS

In 2017, it was found that only 46.7% (30) of municipalities in Sergipe reached the VC target for BCG vaccine; 25.3% (19); for hepatitis A; 26.7% (20) for hepatitis B; 22.7% (17) for meningococcal C; 21.3% (16) for pentavalent; 33.3% (25) for pneumococcal; 24% (18) for polio; 16% (12) for MMR 30.7% (23) and for RV. MMRV, MMR (73.3%) and pentavalent (72%) vaccines had very low and low coverage in most municipalities (Figure 1).
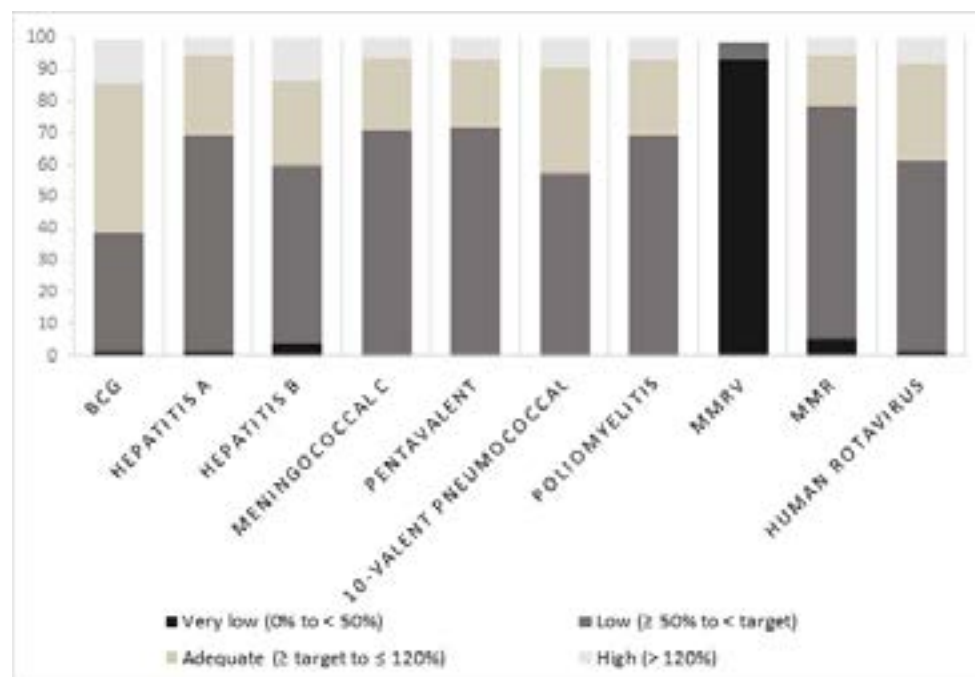

Figure 1 - Proportion of the ten vaccines according to the classification of vaccine coverage. Sergipe, Brazil, 2017

The vaccine coverage homogeneity for BCG was adequate for PQAVS in 27 (36.0%) municipalities and COAP 33 (44%). Regarding the other vaccines, only MMR and PCV-10 did not obtain homogeneity for PQAVS or COAP, respectively. Of the 75 municipalities in Sergipe, 70 (94.6%) had a homogeneity for the viral MMRV characterized as very low, followed by viral triple and hepatitis B. All the vaccines analyzed showed a certain degree of very low homogeneity among the municipalities in Sergipe, as shown in Table 1.

Table 1 - Proportion of classifications obtained by each vaccine according to the stratification of vaccine coverage homogeneity (VCH) in 2017. Sergipe, Brazil, 2017

Vaccine	Zero		Very low (≥0 % to <50%)		Low (≥50% to <75%)		Adequate for COAP[a] (≥75% to <100%)		Adequate for PQAVS[b] (=100%)	
	N	(%)	N	(%)	N	(%)	N	(%)	N	(%)
BCG	-	-	1	1.3	14	18.7	33	44	27	36
Hepatitis A	-	-	1	1.3	15	20	41	54.7	18	24
Hepatitis B		-	3	4	18	24	32	42.7	22	29.3
Meningococcal C	-	-	-	-	16	21.3	44	58.7	15	20
Penta	-	-	-	-	19	25.3	41	54.7	15	20
PCV-10	-	-	-	-	11	-	45	-	19	25.3
Poliomyelitis	-	-	-	-	20	26.7	39	52	16	21.3
MMR	-	-	70	94.6	2	2.7	2	2.7	-	-
MMRV	-	-	4	5.3	26	34.7	30	40	15	20
Rotavirus	-	-	1	1.3	18	24	43	57.3	13	17.3

[a]COAP: public action organizational contract, [b]PQAVS: Qualification Program of Surveillance Actions in Health.

The percentage of municipalities with a low dropout proportion ranged from 1.3% for MMR vaccine to 53.3% for meningococcal C conjugate. The MMR viral vaccine had the highest percentage of municipalities with a high dropout ratio 73 (97.3%) followed by polio 37 (49.3%), pentavalent 33 (44%), Human rotavirus 30 (40%); the lowest dropout percentage was for meningococcal C conjugate, as shown in Figure 2.
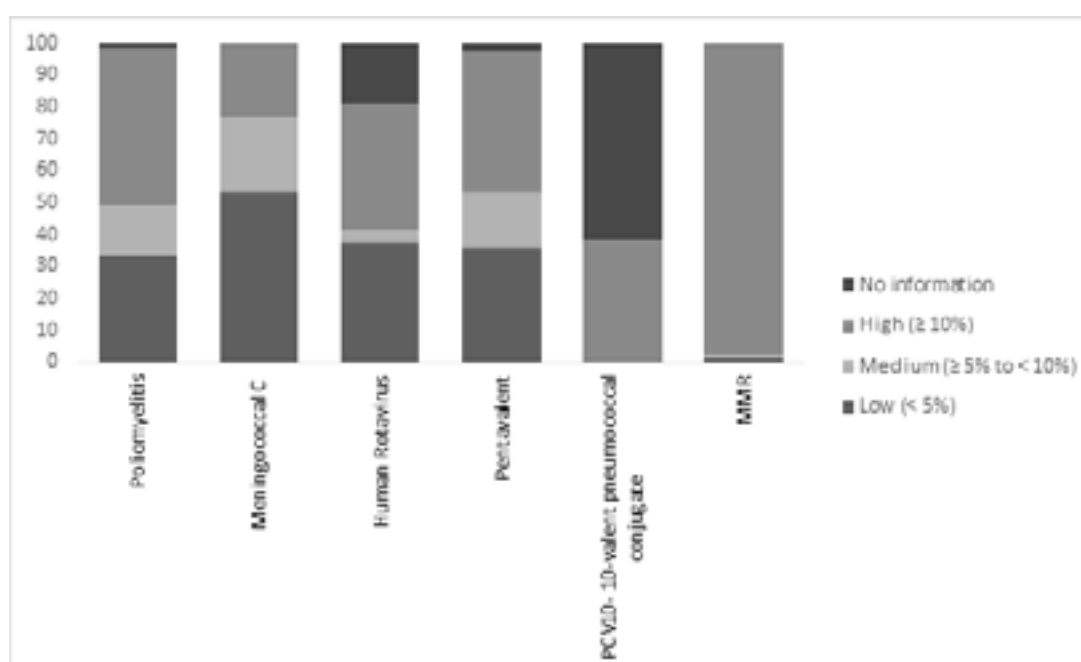

Figure 2 - Distribution of municipalities of Sergipe according to the dropout proportion (DP) of six vaccines in 2017. Sergipe, Brazil, 2017

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Of the 75 municipalities in Sergipe, 64 (85.3%) are at high risk for developing diseases that are possible to be prevented. These data are followed by municipalities with medium risk 8 (10.6%) and very high risk 3 (4.0%), which may directly reflect the risk of vaccine-preventable diseases to re-emerge (Figure 3).

Figure 3 - Distribution of municipalities of Sergipe, according to the risk classification of transmission of vaccine-preventable diseases based on ten vaccines in the child's schedule, in the year 2017. Sergipe, Brazil, 2017

DISCUSSION

This study shows that almost half of the municipalities of Sergipe do not have adequate vaccination coverage for some vaccines recommended in the child's vaccination schedule up to the second year of life, which corroborates with other studies that also reflect the reality of other locations, whether at the local/national and/or international level[15,16,17].

Since the 1990s, childhood vaccination coverage has been above 95%, as proposed by the Ministry of Health[18], which indicated a good adherence by the population to the vaccination scheme. However, as of the year 2016, these coverages went through an important decline of about 10 to 20 percentage points/year[19]. This was unexpected and was followed by an increase in infant and maternal mortality, besides the resurgence of vaccine-preventable diseases considered eliminated in the country[20] such as the measles epidemics that occurred in Roraima and Amazonas, which are immediate consequences of the decrease in vaccination coverage[21].

Vaccination rates in children against seventeen vaccine-preventable diseases, including measles, reached the lowest levels in 2017, evidenced by inadequate vaccine coverage, as shown in a study conducted in São Paulo[9].

It is worrisome that only 16% of the 75 municipalities in Sergipe have an adequate VC for the MMR vaccine, in line with the resurgence of measles cases in Brazil, as well as in other locations, which revealed a 400% increase in cases in the European continent[22,23]. It is worth noting that anti-vaccination movements have a strong influence and are becoming more frequent and persuasive. These movements use strategies such as distortion and dissemination of fake information that question the efficacy and safety of several vaccines

and, in most cases, such reports relate vaccines, such as triple viral, to the occurrence of autism in children[24,25].

This is one of the biggest challenges to be overcome by the national immunization program, which is to maintain the goals of VC, as well as VCH among municipalities, besides combating anti-vaccination movements; and several reasons contribute to the coverage being considered sub-optimal, such as: the fake news disseminated, the anti-vaccination social movements and concerns about the safety and efficacy of the vaccine based on religious or philosophical beliefs[26,27].

The joint analysis of the VC, VCH and dropout proportion indicators allows a better understanding of the risk of transmission of vaccine-preventable diseases in the municipalities, constituting a tool for managers to direct their actions promptly in the places that present the greatest fragility of the vaccination status[14].

In response to threats and the resurgence of diseases, the PNI implemented global/regional child immunization strategic plans to increase monitoring of vaccination indicators and coverage in the country[28], however, many children still do not receive adequate and timely doses[29]. Therefore, monitoring of vaccination coverage is essential to assess the effectiveness of immunization programs, ensuring equity in access and the safety of vaccines.

The present study allowed us to identify that most municipalities in Sergipe have a high risk of resurging vaccine-preventable diseases, which corroborates a study carried out in Brazil at the national level in 2016[14].

Vaccine coverage proved to be atypical (very low; or adequate) for some vaccines, possibly it may be justified by double registration of applied doses/or data underreporting.

As well as the high number of municipalities with very low coverage homogeneity; and the lack of information on vaccination in some municipalities, this reveals the limitations of the referred research, however, the importance of the data found for further research and reflection of cases of the resurgence of diseases that coincide in time is emphasized.

Despite the limitations that include the use of secondary data and its inherent issues, mainly related to the possible underreporting in the records of the administration of the referred vaccines in the PNI, we observe possible transmission risk areas of vaccine-preventable diseases.

Furthermore, VCH shows a heterogeneous distribution pattern, evidenced by the delimitation of clusters of high-risk areas. The methodological techniques used were effective in delimiting risk areas that deserve to be incorporated into activities with the population, as well as their beneficial use in defining priority areas for intensifying investments and control activities.

CONCLUSION

It is concluded that more than half of the municipalities in Sergipe have a high risk and a high chance of transmitting vaccine-preventable diseases to resurgence, therefore, it is important that the state carries out more effective immunization activities within basic health services to raise vaccination coverage, implement a timely surveillance system capable of combating anti-vaccination movements and that everyone involved in this process emphasizes the safety of vaccines as well as the benefits they provide to society.

Health services that are successful in achieving this intention are betting on a close and direct relationship between professionals, managers and the community, to generate crucial results and, above all, a change in the current panorama of vaccine coverage as well

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as its homogeneity and consequent risk reduction in transmission of vaccine-preventable diseases.

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Corresponding author:
Jéssica Oliveira da Cunha
Universidade Federal de Sergipe
Av. Marechal Rondon, s/n - 49100-000 - São Cristóvão, SE, Brasil
E-mail: jessicaocunha@hotmail.com