VACINNATION COVERAGE INDICATORS FOR RISK CLASSIFICATION OF VACCINE-PREVENTABLE DISEASES

Indicadores de cobertura vacinal para classificação de risco de doenças imunopreveníveis

Indicadores de cobertura de vacunación para la clasificación de riesgo de enfermedades inmunoprevenibles

Aline Beatriz dos Santos Silva iD
Federal University of Pernambuco (*Universidade Federal de Pernambuco - UFPE*) - Recife (PE) - Brazil

Ana Catarina de Melo Araújo iD
Pernambuco State Health Secretariat (*Secretaria Estadual de Saúde de Pernambuco - SES*) - Recife (PE) - Brazil

Michelle Caroline da Silva Santos iD
Pernambuco State Health Secretariat (*Secretaria Estadual de Saúde de Pernambuco - SES*) - Recife (PE) - Brazil

Maria Sandra Andrade iD
Pernambuco State University (*Universidade Estadual de Pernambuco - UPE*) - Recife (PE) - Brazil

Rafael Mota Mendonça iD
Federal University of Pernambuco (*Universidade Federal de Pernambuco - UFPE*) - Recife (PE) - Brazil

ABSTRACT

Objective: To describe vaccination coverage indicators and the risk of transmission of vaccine-preventable diseases. **Methods:** This is a descriptive ecological study whose unit of analysis consists of the municipalities of the 1st Health Region of the state of Pernambuco. The methodology proposed by the Ministry of Health and prepared in 2016 was used to classify the risk of vaccine-preventable diseases and data were collected from the Information System of the National Immunization Program of the State. Variables related to the vaccination status of the basic vaccines for children under two years of age (vaccination coverage, abandonment rate and homogeneity of vaccination coverage) and the risk of vaccine-preventable diseases were described through the distribution of absolute and relative frequencies and means. **Results:** Of the twenty municipalities analyzed, 20% (n=4) were at very high risk, 55% (n=11) were at high risk, 15% (n=3) were at intermediate risk and 10% (n=2) were at very low risk. The Tetra viral, Rotavirus and Meningococcal C vaccines had the lowest coverage values in the region: 25% (n=5) of the municipalities reached the goal of homogeneity of vaccination coverage between vaccines and 20% (n=4) of the municipalities scored zero on this indicator. The Rotavirus, Pentavalent and Poliomyelitis vaccines had the highest abandonment rates. **Conclusion:** The municipalities analyzed fall into the categories of very high and high risk and present low rates of vaccination coverage, thus showing that there is an inversely proportional relationship between risk and indicators.

Descriptors: Epidemiology, Descriptive; Vaccination Coverage; Immunization; Risk.

RESUMO

Objetivo: Descrever os indicadores de cobertura vacinal e o risco de transmissão de doenças imunopreveníveis. Métodos: Estudo ecológico descritivo, tendo como unidade de análise os municípios da 1ª Região de Saúde do estado de Pernambuco. Utilizou-se a metodologia proposta pelo Ministério da Saúde, elaborada no ano de 2016, para classificação de risco de doenças imunopreveníveis, e coletaram-se os dados no Sistema de Informações do Programa Nacional de Imunizações do estado. Descreveram-se as variáveis referentes à situação vacinal das vacinas básicas para os menores de dois anos de idade (cobertura vacinal, taxa de abandono e homogeneidade da cobertura vacinal) e o risco de transmissão de doenças imunopreveníveis a partir da distribuição de frequências absolutas, relativas e médias. Resultados: Dos vinte municípios analisados, 20% (n=4) apresentaram a classificação de risco muito alto, 55% (n=11) tiveram risco alto, 15% (n=3) apresentaram risco médio e 10% (n=2) classificaram-se com risco muito baixo. As vacinas tetra viral, rotavírus e meningocócica C apresentaram os menores valores de cobertura na região: 25% (n=5) dos municípios alcançaram a meta da homogeneidade da cobertura vacinal entre vacinas e

20% (n=4) dos municípios estão com esse indicador zerado. As vacinas rotavírus, pentavalente e poliomielite apresentaram as maiores taxas de abandono. **Conclusão:** Nos municípios analisados há um enquadramento nas categorias de risco muito alto e alto, além de baixos indicadores de cobertura vacinal, evidenciando que há uma relação inversamente proporcional entre o risco e os indicadores.

Descritores: *Epidemiologia Descritiva; Cobertura Vacinal; Imunização; Risco.*

RESUMEN

Objetivo: *Describir los indicadores de cobertura de vacunación y el riesgo de transmisión de enfermedades inmunoprevenibles.* **Métodos:** *Estudio ecológico descriptivo que tiene como la unidad de análisis los municipios de la 1ª Región de Salud del estado de Pernambuco. Se utilizó la metodología propuesta por el Ministerio de la Salud elaborada en el año de 2016 para la clasificación de riesgo de enfermedades inmunoprevenibles y se recogieron los datos del Sistema de Informaciones del Programa Nacional de vacunas del estado. Se describieron las variables referentes a la situación de vacunación de las vacunas básicas para los que tienen menos de dos años de edad (cobertura de vacunación, tasa de abandono y homogeneidad de la cobertura de vacunación) y el riesgo de transmisión de enfermedades inmunoprevenibles a partir de la distribución de frecuencias absolutas, relativas y medias.* **Resultados:** *De los veinte municipios analizados, el 20% (n=4) presentaron la clasificación de riesgo muy alto, el 55% (n=11) tuvieron riesgo alto, el 15% (n=3) presentaron riesgo medio y el 10% (n=2) se han clasificado de riesgo muy bajo. Las vacunas tetra viral, rotavirus y la antimeningocócica C presentaron los valores más bajos de la cobertura en la región: el 25% (n=5) de los municipios han alcanzado la meta de la homogeneidad para la cobertura de vacunación entre vacunas y el 20% (n=4) de los municipios tiene cero para ese indicador. Las vacunas rotavirus, pentavalente y poliomielitis presentaron las más altas tasas de abandono.* **Conclusión:** *Hay un encuadramiento de las categorías de riesgo muy alto y alto en los municipios analizados, además de bajos indicadores de cobertura de vacunación con la evidencia de una relación inversamente proporcional entre el riesgo y los indicadores.*

Descriptores: *Epidemiología Descriptiva; Cobertura de Vacunación; Inmunización; Riesgo.*

INTRODUCTION

Vaccination is an essential element in the right to health and a component of governmental responsibility which – in its broad concept – constitutes a duty of the Brazilian Government. Thanks to immunization, about 2.5 million deaths per year are prevented, thus showing that properly protected children tend to have a healthier development[1].

Immunization practices are important activities of primary care offered by the Family Health Strategy and thus help in the sharing of responsibilities and work as a health promoting agent that acts favorably on the quality of life of individuals. They bring to light the potentiality of immunization activities as a health-promoting tool as they are closely linked to improved quality of life by strengthening the immune system and mitigating the risks of acquiring and transmitting communicable diseases. Therefore, the role of health professionals working in this area is fundamental to guaranteeing the population's quality of life as the population considers them the main and most reliable source of information[2].

In addition, vaccination is a cost-effective and efficient public health tool, and its impact on public health features several important issues, such as increased life expectancy (the advent of vaccination has been able to mitigate mortality, which had significant figures back in time), the eradication of certain diseases (such as smallpox) and the guarantee of social and economic benefits[3].

In Brazil, the National Immunization Program (*Programa Nacional de Imunização – PNI*) was instituted in 1973 and two years later its technical operating standards were formalized[4]. Routine vaccination, the National Vaccination Day, periodic campaigns and surveillance system are strategies directed by the PNI to tackle vaccine-preventable diseases[5].

Maintaining coverage high in the estimated standards and homogeneity lead to the effectiveness of vaccines at the individual and collective levels and constitute a good public health indicator capable of overcoming the social gap often created by the health system itself[6].

Since the 1990s the behavior of vaccination coverage in Brazil has been positive, a result of the population's acceptance of vaccination and the success of the PNI. However, the strengthening of the anti-vaccine movement is undeniable and it contributes to the decrease of vaccine coverage and favors the reintroduction of already eradicated vaccine-preventable diseases[7-9]. Although still incipient in Brazil, this movement diminishes the importance of immunization and generates negative information (especially on social media) on the theme and makes the population hesitate to vaccinate children[8].

In 2010, the Ministry of Health (MoH) conducted a national study with the methodological proposal of monitoring, analyzing and evaluating vaccine coverage and hence identifying the risks of transmission of vaccine-preventable diseases. The proposal was updated in 2016 with indicators that reflect vaccination coverage and with the stratification of the risk of disease transmission in the municipalities[5,10].

With the current scenario of resurgence of vaccine-preventable diseases, the anti-vaccine movement and the abandonment of multidose regimens by the population induce behaviors and attitudes that increase the risk of transmission of these diseases, both individually and in the social and community networks of the individual[11].

In this context, this study made it possible to describe vaccination coverage indicators and the risk of transmission of vaccine-preventable diseases.

METHODS

This is a descriptive ecological study whose unit of analysis was the 1st Health Region of the state of Pernambuco (*1ª Região de Saúde do estado de Pernambuco – 1ªRS/PE*), which is composed of nineteen municipalities plus the state district of Fernando de Noronha, as shown in Figure 1. This region was chosen because it is the most populous region in the state and has several health care technologies (Primary Health Care; Outpatient and Hospital Care; Urgency and Emergency; Psychosocial Care and Health Surveillance). In addition, it is a region of expressive migration, which represents a challenge for local public health regarding the control of and access to demographic and epidemiological data of these individuals[12-14].

Figure 1 -. Geographic location of the 1st Health Region of the State of Pernambuco State, 2017.
Legend: Plano Diretor de Regionalização/Secretaria Estadual de Saúde de Pernambuco-SES/PE, 2011[13].

Information was obtained through secondary data from the Information System of the National Immunization Program (*Sistema de Informação do Programa Nacional de Imunizações - SI- PNI*) of the state of Pernambuco and DATASUS (http://datasus.saude.gov.br/). The information obtained was standardized according to the research objective and the eligibility criteria following the computation of the variables for further descriptive analysis using the distribution of absolute, relative and mean frequencies. The year 2017 was chosen because it was the last year with full information and data entry was closed on the DATASUS website[15].

Vaccines recommended for children under two years of age were included, as per the 2018 schedule: pentavalent (three doses), injectable polio (three doses), 10-valent pneumococcal (two doses), human rotavirus (two doses), meningococcal C (two doses), triple viral, tetra viral, and hepatitis A[16].

In view of the paradigm shift regarding the birth process, in which women's autonomy and protagonism lost their place to obstetric techniques and hospitalization, the BCG (Bacillus Calmette-Guérin) and hepatitis B vaccines were excluded from the study[17]. These vaccines are recommended at birth and because many municipalities do not have childbirth care there is an intermunicipal displacement of pregnant women. This phenomenon may interfere with the masking of the actual coverage for these vaccines in the municipalities[18].

The yellow fever vaccine was also not included because the state of Pernambuco is not an area where this vaccine is recommended. The booster shots of the vaccines analyzed were not included as the basic regimen – and not booster shots – is used for the analysis of susceptibles[19].

The risk of transmission of vaccine-preventable diseases is the dependent variable described in the study. The following independent variables were used: vaccine coverage (VC), which consists of the percentage of vaccinated people in the target population for each vaccine; the abandonment rate (AR), which is an indicator applied to immunobiologicals with a multi-dose regimen and represents user adherence to the vaccination system[13]; and vaccine

coverage homogeneity (VCH) between vaccines, which measures the proportion of vaccines within a geographic context that achieves adequate and high coverage[20].

VC rates calculated by the MoH for each municipality were used and the mean regional VC rates were calculated using the rates of the municipalities. Vaccine goals consist of 90% for human rotavirus and 95% for pentavalent, polio, 10-valent pneumococcal, meningococcal C (conjugate), triple viral, tetra viral and hepatitis A. Three vaccination coverage classifications are proposed: low (<goal), adequate (≥goal to ≤120%) and high (>120%). The following stratification was used for the abandonment rate: low (<5%), medium (≥5% to ≤10%) and high (>10%)[13].

VCH was calculated for each municipality by summing the vaccines with adequate and high VC and dividing the total by the number of total vaccines analyzed and multiplying the result by 100. The calculation of the AR considered the difference between the number of first doses and the number of last doses divided by the number of first doses and multiplying the result by 100[13].

According to Resolution CIB/PE No. 3.013 of June 8, 2017, which approves guidelines, objectives, indicators and goals for the state of Pernambuco, the indicator of vaccine coverage homogeneity between vaccines for children under two years of age should reach at least 75%[21]. Thus, the classification of the methodology used by the MoH for this indicator was adapted because the state of Pernambuco adopts the proportion of 75% of this resolution[21]: low (<75%) and adequate (≥75%).

The descriptive risk analysis did not include the size of the population of the municipalities because the Brazilian Institute of Geography and Statistics (*Instituto Brasileiro de Geografia e Estatística - IBGE*) currently uses population estimates, which makes these data unreliable for each municipality[22].

Risk stratification was as follows: very high risk when VCH <75% and AR ≥10% or when municipalities have no vaccination records; high risk when VCH <75%; medium risk when VCH ≥75% to <100% and VC below the recommended for polio, triple viral, tetra viral or pentavalent; low risk when VCH ≥75% to 100% and adequate VC for polio, triple viral and tetra viral; and very low risk when VCH is 100%[13].

Excel (Microsoft Excel) version 2013 and TabWin (Ministry of Health), version 4.15 were used to build the database and analyze the data. The study complied with the ethical considerations proposed by Resolution No. 466 of the National Health Council (*Conselho Nacional de Saúde – CNS*) of December 12, 2012 and was submitted to and approved by the Research Ethics Committee (Approval No. 3.075.787).

RESULTS

The triple viral (114.7%), pneumococcal (102.7%), polio (99.5%), pentavalent (99.4%) and hepatitis A (96.8%) vaccines presented adequate mean regional VC. However, the mean rates of tetra viral (79.6%), rotavirus (85.1%) and meningococcal C (94.6%) vaccines were below the regional target and reflect the higher percentage of municipalities with very low and low VC, as shown in Figure 2.
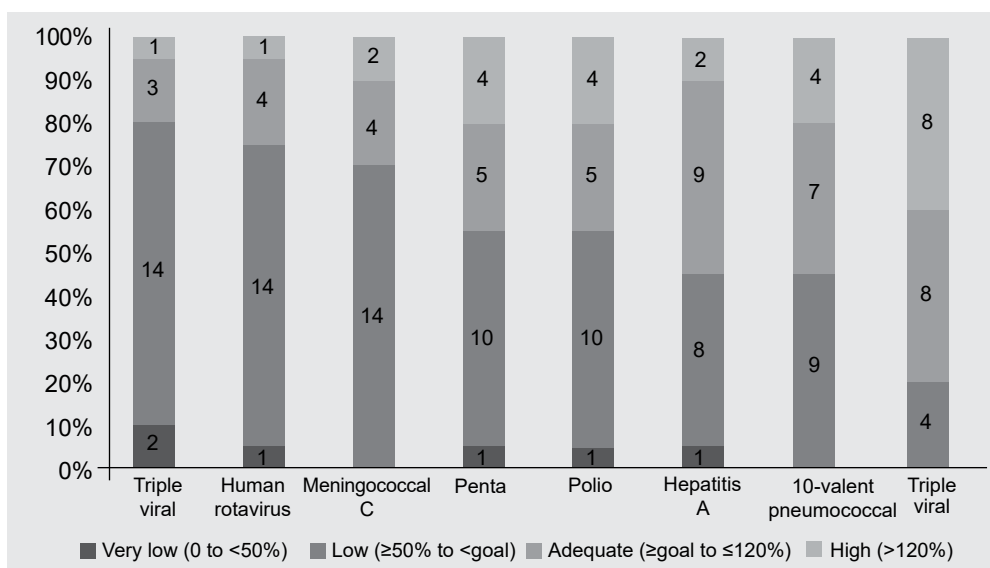

Figure 2 - Distribution of the municipalities (n and %) according to the classification of the vaccine coverage for eight vaccines in the 1st Health Region of the state of Pernambuco, 2017.
Source: SIPNI: Sistema de Informação do Programa Nacional de Imunização; DATASUS: Departamento de Informática do Sistema Único de Saúde

Fernando de Noronha and Ilha de Itamaracá achieved adequate and high VC – respectively – for all vaccines. In the descriptive analysis of VCH between the vaccines, 25% (n=5) of the municipalities reached the target of 75% advocated by Resolution CIB/PE No. 3.013 of June 8, 2017[21], as shown in Figure 3.
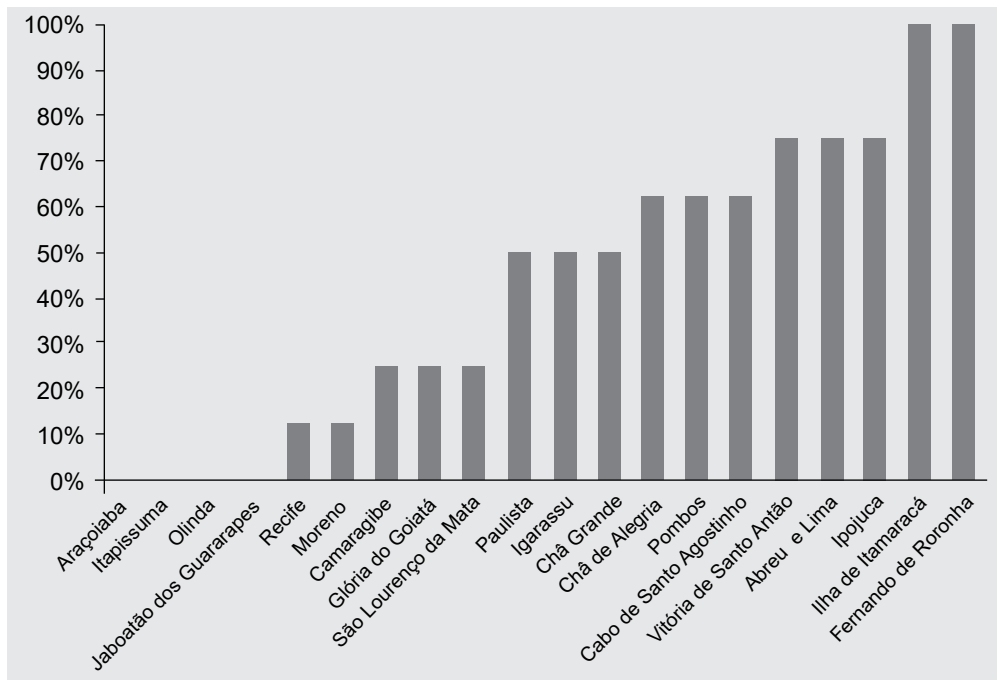

Figure 3 - Vaccine coverage homogeneity between vaccines in the 1st Health Region of the state of Pernambuco, 2017.
Legend: SIPNI: Sistema de Informação do Programa Nacional de Imunização; DATASUS: Departamento de Informática do Sistema Único de Saúde

The regional AR was 5.34% and is considered a medium AR according to the MoH parameters. The municipalities of Gloria do Goitá (16.21%), Camaragibe (13.55%) and Moreno (11.83%) presented the highest mean AR. In addition, 45% of the municipalities presented medium AR and 40% presented low AR, with Fernando de Noronha district exhibiting the lowest mean AR in the region.

In the 1ª RS/PE, the meningococcal C vaccine was the one with the largest proportion (70%) of municipalities with low abandonment rates in municipalities in contrast to the rotavirus vaccine (20%), as shown in Figure 4.
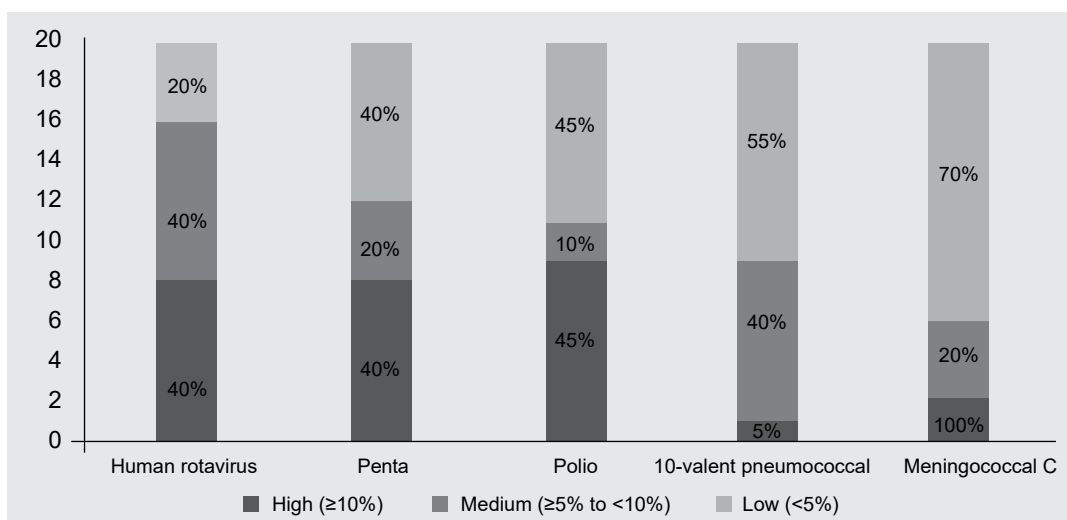

Figure 4 - Distribution of the municipalities (n and %) of the 1st Health Region according to abandonment rates for five vaccines. Pernambuco, 2017.
Source: SIPNI: Sistema de Informação do Programa Nacional de Imunização; DATASUS: Departamento de Informática do Sistema Único de Saúde

The risk of vaccine-preventable disease transmission for each municipality was categorized using the independent variables, as shown in Figure 5.
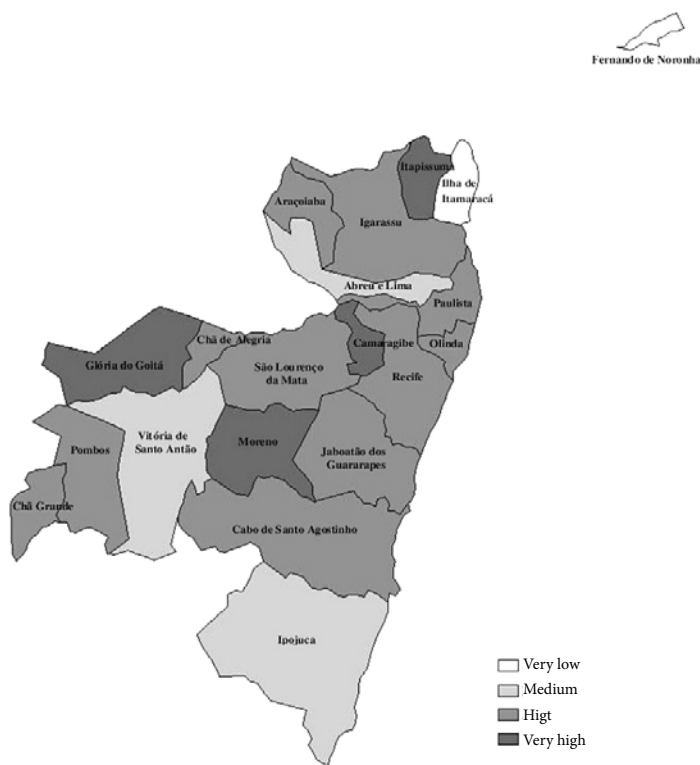

Figure 5 - Risk of transmission of vaccine-preventable diseases in the municipalities of the 1st Health Region of the state of Pernambuco, 2017.
Source: TabWin version 4.15

DISCUSSION

The results found in the present study corroborate the idea that the PNI still faces important challenges, especially local ones, in the fight against vaccine-preventable diseases. The mean rates of VC in the 1ª RS/PE were low for some vaccines, especially for the tetra viral, which has been on the National Immunization Schedule since 2013 to alleviate complications, severe cases and deaths from chickenpox and to prevent measles, rubella and mumps[23].

A study conducted in the state of Ceará showed that some of its municipalities also presented low coverage for the triple viral (measles, rubella and mumps) vaccine and had confirmed cases of measles in 2015[24]. There are some justifications for the emergence of these outbreaks, which refer precisely to the importation of cases, the high transmissibility of these diseases and the lack of homogeneity of vaccine coverage, thereby making part of the population susceptible[25].

Not only Brazil, but other countries also still face endemic diseases against which the tetra viral vaccine protects (measles, rubella, mumps and chickenpox). In Europe, in 2017, Italy and Romania were the leading countries in number of measles cases. In addition, Italy and Austria are the leading countries in number of positive cases of rubella, which make health authorities in the countries receiving these importations aware of their vaccination coverage and the risk of circulation of these diseases[26].

In contrast to the results of the present study regarding the tetra viral vaccine coverage, Cuba, since the implementation of the Immunization Program in 1962 (when morbidity and mortality rates were high for vaccine-preventable diseases), has improved its vaccine indicators. In 2016, measles and rubella coverage reached 100% and incidence and mortality rates were zero[27].

With regard to homogeneity in the 1ª RS/PE, few municipalities had adequate and high VC for all the vaccines analyzed. Therefore, there is a need for immunization and surveillance strategies in municipalities with low VC in order to avoid an unfavorable epidemiological scenario[28]. This indicator is commonly used in Brazil to analyze the achievement of vaccine coverage targets within a geographical context[13].

An important aspect that is linked to low vaccination coverage is the geographical inequality regarding the distribution of immunobiologicals, as shown by data from a study conducted in 49 African countries using surveys. The study allowed the visualization of the places with the poorest resources and the development of equitable distribution strategies to ensure better health outcomes for African children[29].

Some vaccines stood out in relation to the abandonment rate in this study. These included the rotavirus, pentavalent, polio, 10-valent pneumococcal and meningococcal C vaccines. The vaccine abandonment rate is analyzed in order to explore which factors potentiate this indicator[30].

In a prospective cohort study conducted in São Luís, Maranhão, the factors related to the abandonment rate indicator were: low levels of maternal education; unplanned and teenage pregnancy; late presentation to prenatal care; increased number of siblings at home; lack of outpatient and or hospital care; and unavailability of vaccines in health care facilities[30].

To better understand the factors involved in the abandonment rate, another study analyzed electronic medical records of children under two years of age belonging to a micro area of the municipality of Rio de Janeiro and found that the 10-valent pneumococcal and meningococcal C vaccines were the ones with the highest abandonment rate[31], a finding that is in contrast to the findings in the present study.

Research has found that the vaccination process is characterized as a phenomenon that also encompasses social factors and that there are other barriers to access to immunobiologicals, such as post-vaccination reactions (pain and fever) and caregiver unemployment[32].

In the present study, the highest abandonment rate was for the rotavirus vaccine. The cause of rotavirus diarrhea is still a current public health issue that causes problems mainly for children under the age of five worldwide[33]. Therefore, efforts are needed in vaccine strategies to mitigate the abandonment rate for this vaccine in the analyzed region given the impact that the disease has on child health[33].

World Health Organization data on the pentavalent vaccine, for which the abandonment rate was the second largest in this study and which is a conjugated vaccine against diphtheria, tetanus, pertussis, hepatitis B, and Haemophilus influenzae type b (Hib) strains, indicate that 1 out of every 10 children worldwide did not receive the first dose of DTP (diphtheria, tetanus and pertussis) vaccine, and worldwide coverage of this vaccine was 86%. The third dose of this vaccine is considered an indicator of childcare coverage assessment[34].

With regard to pertussis, which is one of the diseases against which the pentavalent vaccine prevents, a study conducted in Minas Gerais showed an increase in its incidence from 2005 to 2014 as a result of vaccination coverage below 90% and therefore below the goal advocated by the MoH. This represents an alert for possible outbreaks in children since contact occurs directly[35].

As for diphtheria, the state of Roraima reported five cases of diphtheria, from 1989 to 2017 – all of them in the capital Boa Vista – due to the low vaccination coverage and lack of homogeneity[36]. In Pernambuco, in 2015 alone, eleven cases of diphtheria were confirmed and were distributed in the municipalities of Chã Grande, Salgueiro, Recife and Jaboatão dos Guararapes[37]. This confirms the importance of completing the vaccination schedule for children, who are more vulnerable to severe cases.

Child health is a priority strategy in the health agenda. The integral promotion of their health has as its main goal the reduction of morbidity and mortality, which still affect this public. Thus, immunization practices, with the guarantee of high coverage, decreased abandonment rates and, consequently, decreased risk of transmission, are closely associated with the achievement of this goal as it is an essential element of growth and development in childhood[38].

An important point to be discussed refers to the continuing education of professionals who carry out immunization activities as the population considers them the main source of information and which interferes with the vaccination coverage and the health-disease process in children[2,39]. One study pointed out that most primary care professionals could not adequately answer which vaccines should be administered at certain ages, thereby showing that the training process should be continuous[39].

Complete dependence on adults is a feature that makes the children's health-disease process a priority for both their guardians and direct caregivers and for policies targeted at this public. Thus, the actions and strategies must be intra and intersectoral and should include health protection and promotion actions in order to mitigate risks and vulnerabilities and ensure a harmonious and healthy development[40].

The joint analysis of vaccine indicators allowed a better understanding of the real vaccination scenario of the places. Constant evaluations and strategic actions are needed to change the epidemiological risk profile[13] of the municipalities of the 1ª RS/PE. This requires joint efforts (by the various social sectors involved) in the planning and incorporation of effective and, especially, universal measures[35].

CONCLUSION

The municipalities analyzed fall into the categories of very high and high risk and present low rates of vaccination coverage, thus showing that there is an inversely proportional relationship between risk and indicators.

CONFLICTS OF INTEREST

The authors declare there are no conflicts of interest.

CONTRIBUTIONS

Aline Beatriz dos Santos Silva, **Ana Catarina de Melo Araújo**, **Michelle Caroline da Silva Santos** and **Maria Sandra Andrade** contributed to the study design and conception; acquisition, analysis and interpretation of data; and writing the manuscript. **Rafael Mota Mendonça** contributed to the acquisition, analysis and interpretation of data.

REFERENCES

1. Organização Mundial da Saúde. Plan de acción mundial sobre vacunas 2011–2020 [Internet]. Genebra: OMS; 2013 [accessed on 2019 Jan 18]. Available from: https://www.who.int/immunization/global_vaccine_action_plan/DoV_GVAP_2012_2020/es/

2. Assad SGB, Corvino MPF, Santos SCP, Cortez EA, Souza FL. Educação Permanente em Saúde e atividades de vacinação: revisão integrativa. Rev Enferm UFPE [Internet]. 2017 [accessed on 2019 July 02];11(Suppl.1):410-21. Available from: https://periodicos.ufpe.br/revistas/revistaenfermagem/article/view/11922

3. Lima AA, Pinto ES. O contexto histórico da implantação do Programa Nacional de Imunização (PNI) e sua importância para o Sistema Único de Saúde (SUS). Scire Salutis [Internet]. 2017 [accessed on 2019 Jan 20];(1):53-62. Available from: https://sustenere.co/journals/index.php/sciresalutis/article/view/SPC2236-9600.2017.001.0005

4. Ministério da Saúde (BR). Secretaria de Vigilância em Saúde. Departamento de Vigilância Epidemiológica. Programa Nacional de Imunizações (PNI): 40 anos [Internet]. 2013 [accessed on 2019 Jan 22]. Available from: http://bvsms.saude.gov.br/bvs/publicacoes/programa_nacional_imunizacoes_pni40.pdf

5. Teixeira AMS, Rocha CMV. Vigilância das coberturas de vacinação: uma metodologia para detecção e intervenção em situações de risco. Epidemiol Serv Saúde [Internet]. 2010 [accessed on 2019 Jan 23];19(3):217-26. Available from: http://scielo.iec.gov.br/scielo.php?script=sci_arttext&pid=S1679-49742010000300004

6. Luhm KR, Cardoso MRA, Waldman EA. Cobertura vacinal em menores de dois anos a partir do registro informatizado de imunização em Curitiba, PR. Rev Saúde Pública [Internet]. 2011 [accessed on 2019 Jan 26];45(1):90-8. Available from: http://www.scielo.br/scielo.php?script=sci_arttext&pid=S0034-89102011000100010

7. Sato APS. Qual a importância da hesitação vacinal na queda das coberturas vacinais no Brasil? Rev Saúde Pública [Internet]. 2018 [accessed on 2019 Jan 26];52(96):1-9. Available from: http://www.rsp.fsp.usp.br/artigo/qual-a-importância-da-hesitacao-vacinal-na-queda-das-coberturas-vacinais-no-brasil/

8. MacDonald NE. Vaccine hesitancy: definition, scope and determinants. Vaccine [Internet]. 2015 [accessed on 2019 July 05];33(34):4161:64. Available from: https://www.sciencedirect.com/science/article/pii/S0264410X15005009?via%3Dihub

9. Ministério da Saúde (BR). Sarampo: situação epidemiológica [Internet]. Brasília: Ministério da Saúde; 2018 [accessed on 2019 Feb 18]. Available from: http://www.saude.gov.br/saude-de-a-z/sarampo-situacao-epidemiologica

10. Braz RM, Domingues CMAS, Teixeira AMS, Luna EJA. Classificação de risco de transmissão de doenças imunopreveníveis a partir de indicadores de coberturas vacinais nos municípios brasileiros. Epidemiol Serv Saúde [Internet]. 2016 [accessed on 2019 Feb 19];25(4):745-54. Available from: http://www.scielo.br/scielo.

php?pid=S2237-96222016000400745&script=sci_abstract&tlng=pt

11. Mizuta AH, Succi GM, Montalli VAM, Succi RCM. Percepções acerca da importância das vacinas e da recusa vacinal numa escola de medicina. Rev Paul Pediatr [Internet]. 2019 [accessed on 2019 July 03];37(1):34-40. Available from: http://www.scielo.br/scielo.php?script=sci_abstract&pid=S0103-05822019000100034&lng=en &nrm=iso&tlng=pt

12. Dias S, Gonçalves A. Migração e Saúde. Rev Migrações [Internet]. 2007 [accessed on 2019 Jan 21];(1):15-26. Available from: http://www.uc.pt/fluc/gigs/GeoHealthS/doc_apoio/migracoes_e_saude.pdf

13. Secretaria de Saúde do Estado de Pernambuco (BR). Secretaria Executiva de Regulação em Saúde. Plano diretor de regionalização [internet]. Recife: SES/PE; 2011 [accessed on 2018 Dec 20]. Available from: http://ead.saude.pe.gov.br/mod/resource/view.php?id=707

14. Brasil. Decreto nº 7.508, de 28 de junho de 2011. Regulamenta a Lei nº 8.080, de 19 de setembro de 1990, para dispor sobre a organização do Sistema Único de Saúde - SUS, o planejamento da saúde, a assistência à saúde e a articulação interfederativa, e dá outras providências. Diário Oficial da União, 29 de junho de 2011.

15. Ministério da Saúde (BR). Departamento de Informática do SUS-DATASUS. Informações de saúde (TABNET): Assistência à saúde [Internet]. 2017 [accessed on 2019 Mar 06] Available from: http://www2. datasus.gov.br/DATASUS/Estatisticas_TABNET_2017/Mtab2017.htm

16. Ministério da Saúde (BR). Calendário Nacional de Vacinação [Internet]. 2019 [accessed on 2019 Apr 20]. Available from: http://www.saude.gov.br/saude-de-a-z/vacinacao/calendario-vacinacao

17. Velho MB, Santos EKA, Collaço VS. Parto normal e cesárea: representações sociais de mulheres que os vivenciaram. Rev Bras Enferm [Internet]. 2014 [accessed on 2019 Jan 20];67(2):282-9. Available from: http://www.scielo.br/scielo.php?pid=S0034-71672014000200282&script=sci_abstract&tlng=pt

18. Sousa LMO, Araújo ED, Miranda JGV. Caracterização do acesso à assistência ao parto normal na Bahia, Brasil, a partir da teoria dos grafos. Cad Saúde Pública [Internet]. 2017 [accessed on 2019 Jan 21];33(12):1-12. Available from: http://www.scielo.br/scielo.php?pid=S0102-311X2017001205011&script=sci_abstract&tlng=pt

19. Ministério da Saúde (BR). Coordenação Geral do Programa Nacional de Imunização. Nota Informativa Nº 118-SEI/2017-CGPNI/DEVIT/SVS/MS. Atualização das áreas de recomendação para vacinação contra febre amarela [Internet]. 2017 [accessed on 2019 Feb 24]. Available from: http://portalarquivos2.saude.gov.br/images/pdf/2017/novembro/30/SEI_MS-1521369-Nota-Informativa-118-recomendacao-vacina-fa.pdf

20. Domingues CMA, Teixeira AMS, Carvalho SMD. National Immunization Program: vaccination, compliance and pharmacovigilance. Rev Inst Med Trop [Internet]. 2012 [accessed on 2019 Jan 20];54(suppl. 18):22-7. Available from: http://www.scielo.br/scielo.php?script=sci_arttext&pid=S0036-46652012000700009

21. Secretaria de Saúde do Estado de Pernambuco. Resolução CIB/PE nº 3.013 de 08 de junho de 2017. Homologa Diretrizes, Objetivos, Indicadores e Metas Pactuados no ano de 2017 para o Estado de Pernambuco. Diário Oficial do Estado, Poder Executivo, ano XCIV.

22. Instituto Brasileiro de Geografia e Estatística. Pesquisa Nacional de Saúde (PNS): ciclos de vida [Internet]. Rio de Janeiro: IBGE; 2015 [accessed on 2019 Mar 10]. Available from: https://sidra.ibge.gov.br/pesquisa/pns

23. Ministério da Saúde (BR). Secretaria de Vigilância em Saúde. Departamento de Vigilância Epidemiológica. Coordenação-Geral do Programa de Imunizações. Informe Técnico de Introdução da vacina tetra viral [Internet]. 2013 [accessed on 2019 Feb 2]. Available from: http://www.sopape.com.br/data/conteudo/arquivos/informe_tecnico_introducao_vacina_tetraviral.pdf

24. Moura ADA, Carneiro AKB, Braga AVL, Bastos ECSA, Canto SVE, Figueiredo TWS, et al. Estratégias e resultados da vacinação no enfrentamento da epidemia de sarampo no estado do Ceará, 2013-2015. Epidemiol Serv Saúde [Internet]. 2018 [accessed on 2019 Feb 05];27(1):1-8. Available from: http://www.scielo.br/scielo.php?pid=S2237-96222018000100600&script=sci_abstract&tlng=pt

25. Ribeiro C, Menezes C, Lamas C. Sarampo: achados epidemiológicos recentes e implicações para a prática clínica. Almanaque Multidiscip Pesqui [Internet]. 2015 [accessed on 2019 Feb 05];1(2):4-16. Available from:

http://publicacoes.unigranrio.edu.br/index.php/amp/article/view/3343/1568

26. European Center for Disease Prevention and Control. Monthly measles and rubella monitoring report [Internet]. 2017 [accessed on 2019 Feb 05]. Available from: https://ecdc.europa.eu/en/publications-data/monthly-measles-and-rubella-monitoring-report-december-2018

27. Ambrón LL, Torres LIE, Carreras AP, Santana BMG, Sardiña MAG, Aguirre SR, et al. Experiencia cubana em inmunización, 1962-2016. Rev Panam Salud Pública [Internet]. 2018 [accessed on 2019 Feb 06];42:1-9. Available from: http://iris.paho.org/xmlui/handle/123456789/34905

28. Doherty M, Buchy P, Standaert B, Giaquinto C, Prado D. Vaccine impact: Benefits for human health. Vaccine [Internet]. 2016 [accessed on 2019 Feb 07];34:6707-14. Available from: https://www.sciencedirect.com/science/article/pii/S0264410X16309434?via%3Dihub

29. Mosser JF, Gagne-Maynard W, Rao PC, Osgood-Zimmerman A, Fullman N, Graetz N, et al. Mapping diphtheria-pertussis-tetanus vaccine coverage in Africa, 2000-2016: a spacial and temporal modelling study. Lancet [Internet]. 2019 [accessed on 2019 Aug 05];393:1843-55. Available from: https://www.thelancet.com/journals/lancet/article/PIIS0140-6736(19)30226-0/fulltext

30. Silva FS, Barbosa YC, Batalha MA, Ribeiro MRC, Simões VMF, Branco MRFC, et al. Incompletude vacinal infantil de vacinas novas e antigas e fatores associados: coorte de nascimento BRISA, São Luís, Maranhão, Nordeste do Brasil. Cad Saúde Pública [Internet]. 2018 [accessed on 2019 Feb 07];34(3):1-21. Available from: http://www.scielo.br/scielo.php?script=sci_abstract&pid=S0102-311X2018000305012&lng=en&nrm=iso&tlng=pt

31. Filgueiras RS, Schaustz MLR, Filgueiras PS, Fonseca SC. Cobertura vacinal em crianças de até dois anos: o prontuário eletrônico no município do Rio de Janeiro. Acad Rev Cient Saúde [Internet]. 2018 [accessed on 2019 Feb 07];3(1):39-45. Available from: https://smsrio.org/revista/index.php/reva/article/view/402

32. Escobar-Díaz F, Osorio-Merchán MB, De laHoz-Restrepo F. Motivos de no vacunación en menores de cinco años en cuatro ciudades colombianas. Rev Panam Salud Pública [Internet]. 2017 [accessed on 2019 Feb 08];41:1-6. Available from: https://www.scielosp.org/article/rpsp/2017.v41/e123/

33. World Health Organization. Rotavirus vaccines WHO position paper – January 2013. Wkly Epidemiol Rec [Internet]. 2013 [accessed on 2019 Mar 08];88(5):49-64. Available from: http://www.who.int/wer/2013/wer8805.pdf?ua=1

34. World Health Organization. World health statistics 2018: monitoring health for the SDGs, sustainable development goals [Internet]. 2018 [accessed on 2019 Feb 18]. Available from: https://www.who.int/gho/publications/world_health_statistics/2018/en/

35. Castro JM, Cabrera GPB. Avaliação da cobertura vacinal em menores de cinco em um Município do Leste de Minas Gerais. Rev Ensaios Cienc Cienc Biol Agrar Saúde. 2017;21(1):36-41.

36. Benedetti MSG. Difteria em Roraima: análise epidemiológica no período de 1989 a 2017. Braz J Hea Rev [Internet]. 2019 [accessed on 2019 Feb 20];2(1):571-9. Available from: http://www.brjd.com.br/index.php/BJHR/article/view/1136

37. Ministério da Saúde (BR). Sistema de Informação de Agravos de Notificação-SINAN. Difteria [Internet].2015 [accessed on 2019 Feb 19]. Available from: https://portalarquivos2.saude.gov.br/images/pdf/2018/marco/12/BR-Dif-Informe-2015.pdf

38. Damasceno SS, Nóbrega VM, Coutinho SED, Reichert APS, Toso BRGO, Collet N. Saúde da criança no Brasil: orientação da rede básica à Atenção Primária à Saúde. Cien Saúde Colet [Internet]. 2016 [accessed on 2019 Aug 05];21(9):2961-73. Available from: http://www.scielo.br/scielo.php?pid=S1413-81232016000902961&script=sci_abstract&tlng=pt

39. Souza IBJ, Lago EC, Araújo TME, Almeida CAPL, Tapety FI, Carvalho ML. Conhecimento de enfermeiros e médicos de uma microrregião do Nordeste brasileiro sobre a vacinação infantil. Nursing (São Paulo) [Internet]. 2018 [accessed on 2019 Aug 08];21(247):2498-2505. Available from: http://pesquisa.bvsalud.org/portal/resource/pt/biblio-970888

40. Ministério da Saúde (BR). Secretaria de Atenção à Saúde. Departamento de Ações Programáticas Estratégicas. Política Nacional de Atenção Integral à Saúde da Criança: orientações para implementação. Brasília: Ministério da Saúde [Internet].2018.[accessed on 2019 Feb 05]. Available from: http://www.saude. pr.gov.br/arquivos/File/Politica_Nacional_de_Atencao_Integral_a_Saude_da_Crianca_PNAISC.pdf

Mailing address:
Aline Beatriz dos Santos Silva
Universidade Federal de Pernambuco - UFPE
Programa de Pós-Graduação em Saúde Coletiva
Av. Professor Moraes Rego, s/n - Hospital das Clínicas, Bloco E - 4º andar
Bairro: Cidade Universitária
CEP: 50.670-901 - Recife - PE - Brasil
E-mail: alinebeatriz92@gmail.com