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RESEARCH

STRUCTURE AND LOCATION OF VACCINATION SERVICES INFLUENCE THE AVAILABILITY OF THE TRIPLE VIRAL IN BRAZIL

ESTRUTURA E LOCALIZAÇÃO DOS SERVIÇOS DE VACINAÇÃO INFLUENCIAM A DISPONIBILIDADE DA TRÍPLICE VIRAL NO BRASIL

LA ESTRUCTURA Y UBICACIÓN DE LOS SERVICIOS DE VACUNACIÓN INFLUYEN EN LA DISPONIBILIDAD DE LA VACUNA TRIPLE VIRAL EN BRASIL

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ABSTRACT

Objective: to analyze the association of structural factors and geographical differences in the availability of the measle, mumps, and rubella vaccine in primary care services in Brazil. ***Methods:*** this is a cross-sectional study, with secondary data from the second cycle of external evaluations of the Primary Care Quality Improvement Program (*Programa de Melhoria da Qualidade da Atenção Básica* - PMAQ-AB) collected from 19,752 vaccination services across the country between 2013 and 2014. We estimated the prevalence ratio (PR) and their respective 95% confidence intervals (CI 95%) using the Poisson multivariate regression technique with robust variances. ***Results:*** the MMR vaccine was always available in 93% of the services studied, but with regional differences, with the lowest frequency observed in the North (87.4%; p <0.001). The following structural factors of the services were positively associated with the higher frequency of MMR vaccine always available: having a vaccination room (PR: 1.05; 95% CI: 1.01-1.09), exclusive vaccination room for immunization (PR: 1.04; 95% CI 1.02-1.05), refrigerator exclusively for vaccines (PR: 1.13; 95% CI: 1.10-1.16); printed vaccination cards always available (PR: 1.12 95% CI: 1.09-1.16) and coolers for vaccines always available (PR: 1.18 95% CI: 1.14-1.21). ***Conclusion:*** the location and structure of primary care services influenced the availability of the MMR vaccine in Brazil. Services in the North region and with a poor structure for immunization actions showed less frequency of vaccine availability.

Keywords: Measles-Mumps-Rubella Vaccine; Immunization; Primary Health Care; Health Services Accessibility.

RESUMO

Objetivo: *analisar a associação de fatores estruturais e diferenças geográficas na disponibilidade da vacina tríplice viral nos serviços de atenção básica no Brasil.* ***Métodos:*** *estudo transversal, com dados secundários do segundo ciclo das avaliações externas do Programa de Melhoria da Qualidade da Atenção Básica (PMAQ-AB) coletados em 19.752 serviços de vacinação de todo o país entre os anos de 2013 e 2014. Razões de prevalência (RP) ajustadas e seus respectivos intervalos de confiança de 95% (IC 95%) foram estimados com a técnica de regressão multivariada de Poisson com variâncias robustas.* ***Resultados:*** *a vacina tríplice viral estava sempre disponível em 93% dos serviços estudados, mas com diferenças regionais, sendo a menor frequência observada na região Norte (87,4%; p<0,001). Os seguintes fatores estruturais dos serviços associaram-se positivamente à maior frequência de vacina tríplice viral sempre disponível: possuir sala de vacinação (RP: 1,05; IC 95%: 1,01-1,09), sala de vacinação exclusiva para imunização (RP: 1,04; IC 95% 1,02-1,05), geladeira exclusiva para vacinas (RP: 1,13; IC 95%: 1,10-1,16); cartões de vacinação impressos sempre disponíveis (RP: 1,12 IC 95%: 1,09-1,16) e caixas*

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térmicas para vacinas sempre disponíveis (RP: 1,18 IC 95%: 1,14-1,21). ***Conclusão:*** *a localização e a estrutura dos serviços de atenção básica influenciaram na disponibilidade da vacina tríplice viral no Brasil. Serviços da região Norte e com estrutura deficiente para as ações de imunização apresentaram menor frequência da disponibilidade da vacina.*

Palavras-chave: *Vacina contra Sarampo-Caxumba-Rubéola; Imunização; Atenção Primaria à Saúde; Acesso aos Serviços de Saúde.*

RESUMEN

Objetivo: *analizar la asociación entre los factores estructurales y las diferencias geográficas en la disponibilidad de la vacuna triple viral en los servicios de atención primaria de Brasil.* ***Método:*** *estudio transversal con datos secundarios del segundo ciclo de evaluaciones externas del Programa de mejora de la calidad de la atención primaria recogidos en 19.752 servicios de vacunación de todo el país entre 2013 y 2014.Las razones de prevalencia ajustadas (PR) y sus respectivos intervalos de confianza del 95% (IC del 95%) se estimaron utilizando la técnica de regresión multivariante de Poisson con varianzas robustas.* ***Resultados:*** *la vacuna triple viral siempre estuvo disponible en el 93% de los servicios estudiados, pero con diferencias regionales, con la menor frecuencia observada en el norte (87,4%; p <0,001). Los siguientes factores estructurales de los servicios se asociaron positivamente con la mayor frecuencia de vacuna triple viral siempre disponible: tener una sala de vacunación (RP: 1.05; IC 95%: 1.01-1.09), sala de vacunación exclusiva para inmunización (RP: 1,04; IC del 95%: 1,02-1,05), refrigerador exclusivamente para vacunas (RP: 1,13; IC del 95%: 1,10-1,16); tarjetas de vacunación impresas siempre disponibles (RP: 1,12 IC 95%: 1,09-1,16) y cajas térmicas para vacunas siempre disponibles (RP: 1,18 IC 95%: 1,14-1,21).* ***Conclusión:*** *la ubicación y estructura de los servicios de atención primaria influyó en la disponibilidad de la vacuna triple viral en Brasil. Los servicios de la región norte con estructura deficiente para las acciones de inmunización mostraron menor frecuencia de disponibilidad de vacunas.*

Palabras clave*: Vacuna contra el Sarampión-Parotiditis-Rubéola; Inmunización; Atención Primaria de Salud; Accesibilidad a los Servicios de Salud.*

INTRODUCTION

The World Health Organization data reported that measles cases in the world grew very worryingly in the first months of 2019, compared to previous periods.[1] Although is partial data, there are worrying indicators both of outbreaks and low vaccination coverage against the disease in the last three years by many countries, including those located in Latin America.[2]

Between 2015 and October 2018, Brazil also showed a significant drop in the coverage for the measles-mumps-rubella vaccine.[3] During this period, the coverage with the first dose of this immunobiological dropped from 96.1 to 86.7%, and only after the national vaccination campaign in September 2018 again exceeded the target of 95.0%.[4]

These low indicators of vaccination coverage together with measles cases imported from Venezuela triggered an epidemic of the disease affecting several Brazilian states, especially in the Northern region, with 10,354 confirmed cases until March 2019.[5,6] This epidemic made the country to lose its certificate of measles elimination given by the World Health Organization in 2016, and it was characterized as a complex situation in which many factors related to each other may have contributed.[7–9] Some of these factors include the problems with the supply of the MMR vaccine, with shortages in the public health service network that may have played a determining role in limiting access to immunoprevention by the population.[10,11] Thus, assuming that the structure for immunization actions in primary care services may influence the availability vaccine and that the concentration of services with structural problems may favor an increase of individuals susceptible to measles in certain areas,[12] this study aimed to investigate the influence of structural factors in primary care services and regional differences in the availability of the MMR vaccine in Brazil.

When investigating structural factors in primary care services possibly related to the availability of the triple viral vaccine and the regional issues, this study is consistent with the need to adopt increasingly adequate strategies to minimize the risk of spreading preventable diseases.

MATERIAL AND METHOD

This is a cross-sectional study with secondary data from a multicenter and nationwide survey in primary care services that participated in the second cycle of external evaluations of the Primary Care Quality Improvement Program of the Brazilian Ministry of Health.

The database was structured by the Ministry of Health and it has open access. Data collection in external evaluations occurred between 2013 and 2014 and the instrument used was organized in three modules. In this study, we considered the model related to services - Module I.

The original data included 24,427 primary care services, excluding those in which external evaluation had not been applied (n = 372) and those that did not regularly offer vaccination (n = 4,303), totaling 4,675 losses (South region = 18.1%; Southeast = 25.5%; Midwest = 18.6%; Northeast = 14.6%; North = 22.2%; p <0.001). Thus, the sample studied had 19,752 services that covered the 26 federated units and the Federal District.

For services that regularly offered vaccination, we evaluated the availability of the MMR vaccine considering that they were always available (yes/no). In the structure of primary care services, we evaluated the following characteristics, considering the structure that

designates the condition under the care provided:[13] a) type of service (health center, basic health unit and other types of services); b) size of the service (small, medium and large); c) operating in a temporary place (yes/no); d) availability of a vaccination room (yes/no); e) sharing the vaccination room for other activities (yes/no); f) when shared if the vaccine environment was the main one (yes/no); g) availability of refrigeration equipment and coolers for daily use exclusively for vaccines (yes/no); h) and availability of vaccination cards or vaccination booklets always available (yes/no). We also evaluated the location of the services, according to Brazilian geopolitical regions (North, Northeast, Southeast, Midwest, and South).

The data obtained in the Excel program were transferred to the Stata software, version 13.0 used for statistical analysis. First, we analyzed the prevalence of MMR vaccines always available in the services, according to Brazilian regions, considering 95% confidence intervals (CI 95%). Then, according to the Brazilian regions, we analyzed the absolute and relative frequencies of the characteristics of primary care services that regularly offered vaccination. A Poisson multivariate regression model was constructed with robust variances and the prevalence ratios (PR) and their respective 95% CI were estimated to identify associations between the structural characteristics and location of services with the availability of the MMR vaccine. Thus, variables with a value of p <0.20 in the bivariate analysis were inserted into the model, using the step-by-step backward strategy. The level of statistical significance was 5% and all analyzes were weighted by the inverse of the proportion of losses in each region (1/losses).

RESULTS

The MMR vaccine was always available in 93% of the evaluated primary care services. The North of the country had the lowest frequency of availability in the services (Figure 1).

Most of the services studied were small basic health units, operating in permanent facilities with an exclusive vaccination room and refrigeration equipment for vaccines only, and also having cards or vaccination booklets and daily coolers for vaccines. The North region had the lowest frequency of units classified as basic health units and the highest proportion of units that needed to share the vaccination room environment with other actions. The primary care services in the North also had less frequently used daily coolers for vaccines available. The Northeast region had the highest concentration of small services and the lowest frequencies of the vaccination room and refrigeration equipment exclusive to vaccines (Table 1).

Multivariate analysis showed that the availability of the MMR vaccine in Brazilian primary care services varied regionally (Table 2). The vaccine was always available but less frequently in the North. In the structure of the services, the MMR was always available more frequently in services classified as basic health units, which had a vaccination room and did not share it, with exclusive refrigeration equipment for vaccines, vaccination cards or booklets and coolers always available.

	%	Lower limit CI 95%	Higher limit CI 95%
South	94.5%	93.6%	95.3%
Southeast	94.7%	94.1%	95.3%
Midwest	94.8%	93.5%	95.8%
Northeast	92.1%	91.5%	92.6%
North	87.4%	85.5%	89.1%
Brazil	92.9%	92.7%	93.4%

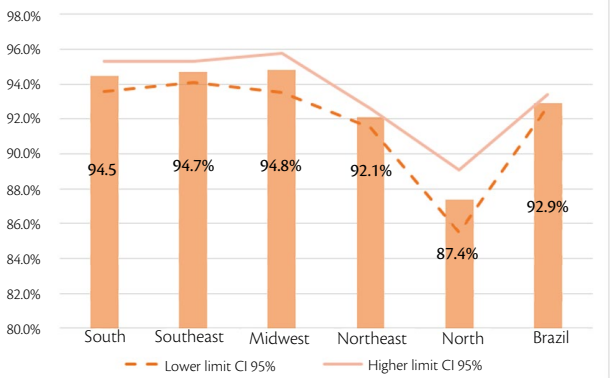

Figura 1 - Prevalência de vacinas tríplice virais nos serviços de Atenção Básica que oferecem regularmente vacinação submetidos à avaliação externa no Programa de Melhoria da Qualidade da Atenção Básica (PMAQ-AB), Brasil, 2013-2014, segundo regiões brasileiras. (n=19.572)

DISCUSSION

The study results showed a relationship between a better structure for immunization actions and more availability of the MMR vaccine. When the services had vaccination rooms and, especially, when they were exclusive for immunization actions, the frequency of the MMR vaccine always available was higher. The structural conditions such as exclusive refrigeration equipment for immunobiological conservation, coolers for daily use and vaccination cards or booklets were related to the higher frequency of MMR vaccine always available. Differences in vaccine availability between Brazilian regions were also evident in the results: the north region of the country reported two measles outbreaks in 2018,[3,7] and was precisely the one with the lowest frequency of MMR vaccine always available.

The frequency of 93% in the availability of the MMR vaccine in primary care services in Brazil is above the reality in other countries.[14] Even temporary, the unavailability of vaccines in primary care services results in missed opportunities, compromise the achievement of vaccination coverage goals and increase the contingent of susceptible individuals in certain areas.[15,16]

Those services with a vaccination room, exclusive refrigeration equipment, coolers for daily use, and vaccination cards or booklets had a more evident availability of the MMR vaccine. These items are

Table 1 - Characteristics of vaccination services in the primary health care that regularly offer vaccination, submitted to an external evaluation in the Primary Care Quality Improvement Program (PMAQ-AB), Brazil, 2013-2014, according to Brazilian regions (n = 19,572)

Variables	South		Southeast		Midwest		Northeast		North		Brazil	
	n	%	n	%	n	%	n	%	n	%	n	%
Type of unit												
Health Center	164	5.6	441	8.3	130	8.4	913	10.6	161	12.0	1.809	9.3
Basic Health Unit	2.596	89	4.448	84.7	1.354	87.4	7.523	87	1.042	77.6	16.999	86.4
Others	158	5.4	369	7.0	66	4.3	212	2.5	139	10.4	944	4.3
Size of the unit												
Small	1.779	61	3.151	59.5	711	45.9	6.728	77.8	839	62.5	13.208	68.7
Medium	907	31	1.368	25.8	647	41.7	1.574	18.2	392	29.2	4.888	23.9
Big	232	8	775	14.6	192	12.4	346	4.0	111	8.3	1.656	7.4
Operating in a temporary place												
Yes	289	9.9	800	15.1	339	21.9	1.833	21.2	258	19.2	3.519	18.3
Vaccine rooms												
Yes	2.855	97.8	5.118	96.7	1.501	96.8	8.097	93.6	1.287	95.9	18.858	95.2
Shared vaccine room environment (n = 18,858)												
Yes	329	11.5	727	14.2	147	9.8	1.258	15.5	205	15.9	2.666	14.3
Exclusive refrigerator for vaccines												
Yes	2.832	97.1	5.015	94.7	1.488	96.0	7.615	88.1	1.276	95.1	18.226	91.6
Printed vaccination cards always available												
Yes	2.831	97.0	4.995	94.4	1.409	90.9	8.156	94.3	1.245	92.8	18.636	94.4
Vaccine coolers always available												
Yes	2.865	98.2	5.021	94.8	1.455	93.9	7.905	91.4	1.182	88.1	18.428	93

essential for the operationalization of routine vaccination activities, vaccination campaigns, and extramural activities at the local level. Therefore, we expected that the frequency of vaccine availability would be higher in the services with these items available.

The difference observed between the types of services regarding the MMR vaccine always available may be related to their different purposes in the Brazilian Unified Health System (*Sistema Único de Saúde* - SUS), providing a better structure for basic health units than in health centers. According to information from the Brazilian Ministry of Health, health centers are units that assist, programmed or not, by a mid-level professional, with the intermittent presence or not of the medical professional. The basic health units are intended to provide permanent comprehensive care to the population provided by a multidisciplinary team.[17]

Primary health care services in the North region had the MMR vaccine always available less frequently, maybe due to having the worst structures when compared to services in other regions of the country.[18] This worst relative structure is linked to public investments in health sectors that are insufficient and highlight regional differences in Brazil.[19] The concentration of services with structural problems in the region and, consequently, less availability of the MMR vaccine may have contributed to have susceptible individuals groups and increased the chances of outbreaks.[3,20]

As this is a cross-sectional and multicenter study, we evaluated and compared the prevalence of the MMR vaccine in health services in different regions of Brazil, relating the availability of the MMR vaccine to the structure of each service. This type of study has an intrinsic limitation that is the impossibility of establishing causal inferences since the data regarding both the characteristics of the services and the availability of the vaccine were collected in a single moment. Another limitation was the lack of evaluation of the basic riverside health units in the PMAQ. Considering the specificities of these units and the service to the riverside communities of the municipalities of *Amazônia Legal* and *Mato Grosso do Sul*, we would need evaluation parameters to consider these specificities.

Effective supply chains of the MMR vaccine together with adequate structures in primary care services and ensuring their continuous availability are fundamental to achieve universal access to immunoprevention and to improve the indicators of vaccine coverage. Due to the increasing notification of measles cases in Brazil and the results of this study, we recommend considering factors related to the structure of primary care services across the national

Table 2 - Analysis of factors associated with the availability of the MMR vaccine in vaccination services in primary health care that regularly offer vaccination, submitted to an external evaluation in the Primary Care Quality Improvement Program (PMAQ-AB), Brazil, 2013-2014 (n = 19,572)

Variables	MMR always available				
	Gross analysis			Adjusted analysis *	
	n (%)	PR (CI 95%)	*p*	PR (CI 95%)	*p*
Type of unit					
Health Center	1.630 (90.1)	1		1	
Basic Health Units	15.585 (93.3)	1.04 (1.02-1.06)	< 0.001	1.02 (1.00-1.03)	0.02
Others	890 (94.3)	1.05 (1.03-1.08)	< 0.001	1.02 (1.00-1.05)	0.03
Size of the unit					
Small	12.221 (92.5)	1			
Medium	4.583 (93.8)	1.01 (1.00-1.02)	0.003		
Big	1.574 (95.0)	1.02 (1.01-1.04)	0.001		
Operating in a temporary place					
Yes	3.248 (92.3)	1			
No	15.130 (93.2)	1.01 (0.99-1.02)	0.102		
Vaccines rooms					
No	695 (77.7)	1		1	
Yes	17.683 (93.8)	1.21 (1.17-1.26)	< 0.001	1.05 (1.01-1.09)	0.021
Shared vaccine room environment (n=18,858)					
Yes	2.366 (88.7)	1		1	
No	15.317 (94.6)	1.07 (1.05-1.08)	< 0.001	1.04 (1.02-1.05)	< 0.001
Exclusive refrigerator for vaccines					
No	1.190 (78.0)	1			
Yes	17.188 (94.3)	1.22 (1.19-1.26)	< 0.001	1.13 (1.10-1.16)	< 0.001
Printed vaccination cards always available					
No	901 (80.7)	1		1	
Yes	17.477 (93.8)	1.17 (1.14-1.21)	< 0.001	1.12 (1.09-1.16)	< 0.001
Vaccine coolers always available					
No	1.010 (76.3)	1		1	
Yes	17.368 (94.2)	1.25 (1.21-1.29)	< 0.001	1.18 (1.14-1.21)	< 0.001
Country Region					
North	1.173 (87.4)	1		1	
Northeast	7.962 (92.1)	1.05 (1.03-1.08)	< 0.001	1.06 (1.03-1.08)	< 0.001
South	2.758 (94.5)	1.08 (1.06-1.11)	< 0.001	1.07 (1.05-1.10)	< 0.001
Southeast	5.016 (94.7)	1.08 (1.06-1.11)	< 0.001	1.07 (1.05-1.10)	< 0.001
Midwest	1.469 (94.8)	1.08 (1.06-1.11)	< 0.001	1.05 (1.03-1.08)	< 0.001

Notes: PR = prevalence ratio; CI = 95% confidence interval; *p* = significance test.
*A poisson regression model with robust variances adjusted by type of unit, size of the unit, operating in a temporary place, vaccine room, shared vaccine room environment, exclusive vaccine refrigerator, printed vaccination cards always available, vaccine coolers always available and country region.

territory in actions aimed at maintaining optimal vaccination coverage with the MMR vaccine. Also, the same factors related to the availability of the MMR vaccine may be implicated in the risk of a resurgence of other vaccine-preventable diseases in the country.

CONCLUSIONS

The location and structure of primary care services influence the availability of the MMR vaccine in Brazil. Services in the North region and with a poor structure for immunization actions had the lowest frequency of vaccine availability.

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