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Tecobé in Marajó: trend of indicators for the monitoring of primary care before and during the More Physicians for Brazil Program

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Abstract *This study aimed to evaluate the performance of the Family Health Strategy after implementation of the More Physicians Program (MPBP) in the territory of Marajó-Pa-Brazil through an historical series of four primary care indicators during 2011-2015: population coverage, proportion of live births to mothers with/without prenatal consultations, hospitalization rates due to primary care sensitive condition (taxas de internações por condições sensíveis à atenção primária - ICSAP) and infant mortality rate. A trend of improvement was evident after implementation of the MPBP in 2013, achieving 42.8% of coverage in December 2015. In April 2014, all 16 municipalities had established teams with physicians. The proportion of live births to mothers with/without prenatal consultations showed increasing trends in most municipalities, increasing by 97% on average, predominantly with seven consultations or more and reducing the proportion of live births to mothers without prenatal visits. The infant mortality rate achieved a downward trend starting in 2014. The results indicate improvements in primary care based on the selected indicators, boosting the Family Health Strategy (FHS) in the studied region.*

Key words *Family Health Strategy, Primary healthcare, Time series studies*

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Introduction

Over the years of its implementation, the Family Health Strategy (FHS) has contributed to reductions in inequalities, especially by broadening the access to basic healthcare services and connecting the teams to individuals, families and communities in the complex task of taking care of life[1]. Even if it is seen as a privileged stage for experimentation and development of preventive practices and assistance, coupled with the principle of comprehensiveness, the Unified Healthcare System (Sistema Único de Saúde – SUS) has always faced insufficient resources[1].

The territorial/geographic factor Graphics as one of the main coadjuvant factors for inequalities in terms of access to and utilization of services in primary healthcare between Brazilian regions. Evidence has shown that the North and Northeast regions were the most affected by severe shortages of physicians, with fierce disparities when comparing capital cities and other cities in Brazilian states[2,3].

In this sense, in 2013, the Federal Government created the More Physicians for Brazil Program (MPBP), through Law no. 12,871 of October 22, 2013, which has among its goals to reduce the shortage of physicians, to strengthen primary care services and to improve medical training in the country[4]. The principles of South-South cooperation between Brazil and Cuba were applied to this program, with participation of the Pan-American Health Organization (Organização Pan-Americana da Saúde - OPAS), to add value to joint activities, promoting systematization and disclosure of experiences[5].

The MPBP was initially implemented in areas that were a priority for the SUS, defined as areas with difficult access, those for which it was difficult to provide physicians or those with populations in more vulnerable situations[4,5]. All of the 16 municipalities that constitute the Marajó Health region, Pará state, fell into that criteria, and the entire region joined the program during its launch.

The region of Marajó-Pará, in the middle of Eastern Amazonia, covers a territorial area corresponding to the area of six southeastern Brazilian states and is considered the largest fluvio-marine archipelago worldwide. Marajó-Pará has a predominantly rural population, the majority of whom are below the poverty line; their socioeconomic indicators have historically shown an abandoned region, in which primary care was always insufficient, mainly due to the high turnover of healthcare professionals, which limited the implementation of the FHS[6].

As a way to assess the impacts of actions and programs implemented to boost primary healthcare, in recent years, the use of healthcare monitoring methodologies has been improved. Thus, weaknesses in the system can be observed, reflecting the health conditions of the studied population, especially due to health indicators, establishing trends over time, assisting the rationalization of public spending and subsidizing decision-making[7-9]. Although there is no standardization for evaluation methods for public health performance and impact, the literature presents a series of studies that sought to demonstrate the effects of the Family Health Strategy both in actions on health and as an existing healthcare model[10-12].

The goal of this study was to evaluate the performance of the Family Health Strategy, from the deployment of the MPBP in Marajó-Pa-Brazil, using the historical series of four primary care indicators in the 2011-2015 period.

Methodology

This study is part of the Research Project titled "Tecobé in Marajó - Impact of the More Physicians for Brazil Program (MPBP) in the Marajó Archipelago-PA-Brazil, from 2013 to 2017" ("Tecobé no Marajó - Impacto do Programa Mais Médicos para o Brasil (PMMB) no Arquipélago do Marajó-PA-Brasil, nos anos de 2013 a 2017").

Aimed at strengthening the integrated SUS planning, the Ministry of Health, the National Council of Health Secretaries (Conselho Nacional de Secretários de Saúde - CONASS) and the National Council of Municipal Health Secretaries (Conselho Nacional de Secretários Municipais de Saúde - CONASEMS) agreed with the implementation of the Public Health Organizational Contract (Contrato Organizativo de Ação Pública da Saúde - COAP), composed of a number of health indicators that allow monitoring access to health actions and services from guidelines established by the National Health Plan[13].

The COAP presents the indicators selected for this descriptive assessment and its construction, which include population coverage estimated by primary care teams, proportion of live births to mothers with/without prenatal consultations (considering seven or more prenatal consultations, four to six prenatal consultations and no prenatal consultation), hospitalization

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rates due to primary care sensitive condition (taxas de internações por condições sensíveis à atenção primária - ICSAP) and infant mortality rate. Such indicators enable the evaluation of the performance of programs implanted in primary care, especially by broadening access regarding the Mother and Infant Healthcare Network in the studied region.

For the calculation of the population coverage in the COAP (in the FHS + in the equivalent FHS) x 3,000/population in the same location and period) x 100, an FHS was considered effectively implemented if it had physicians on the team, according to the information in the National Registry of Health Facilities (Cadastro Nacional dos Estabelecimentos de Saúde - CNES), after crossing between the category physician of the FHS and the category type of facility, informed as Health Center/Basic Health Unit, Health Center or Mixed Center.

The proportion of live births to mothers with/without prenatal consultations (number of live births to mothers residing in a particular location for prenatal consultation/number of live births to mother residents in the same location and period) X 100 was calculated using data from the Live Births Information System (Sistema de Informações de Nascidos Vivos - SINASC).

The crude rates of ICSAP were derived from sheets with hospital morbidity data and the population exposed to the evaluated risk in each studied municipality. The main source of data was the SUS Hospital Information System (HIS-SUS), available in AIH-1 files, from which information on hospitalizations in the states of Pará and Amapá were obtained (where hospitalizations from the Marajó occur), paid up to January 2016, organized into Tables by the municipality of residence, month by month, per year of occurrence, using TabWin software. The CSAPs were classified according to the code of the Tenth Revision of the International Classification of Diseases (CID-10) informed in the field diagnostic at discharge, according to the Brazilian Inpatient List due to CSAP[14].

The infant mortality rate (number of deaths in children younger than one year old in a given location of residence and year/number of live births of residents in the same location and year) X 1,000 was calculated with data obtained from the Mortality Information System (Sistema de Informações sobre Mortalidade - SIM) and SINASC. The data regarding the municipalities were obtained from the *site* of the Department of Informatics of SUS (DATASUS). For the construction of coverage indicators and ICSAP, total estimated population per municipality was used by the Brazilian Institute of Geography and Statistics (Instituto Brasileiro de Geografia e Estatística – IBGE) for the Brazilian federal accountability office (Tribunal de Contas da União) during the study years.

The use of regression methods for time series analysis is known to be an important assessment tool for easy elaboration and interpretation of results because it allows one to analyze the behavior of the studied variables over time, observing established goals being reached and possible factors that influence behavior, seeking to define cause/effect between two or more series, thus helping with the decision making[15]. To allow a time series analysis of indicators until 2014/2015, the historic series was extended to 2011, the year in which the validity of the indicators monitored by the Health Agreement, established by Ordinance 2669 of 11/03/2009, had been completed for more than a year, and a study period that allowed assessment of the trends of these indicators before and after implementation of MPBP, which occurred at the end of 2013.

Initially, scatter diagrams between averages of selected indicators and semesters of study were used, allowing the types of relationship between the factors to be viewed. Next, modeling was performed, considering the dependent variable Y (average of the semester of each monitoring indicator) and the independent variable X (study semester). To avoid collinearity, the variable time was centralized through the midpoint of the historic series.

Simple linear regression models ($Y = \beta_{The} \beta + {}_1 X$), second-degree polynomial models ($Y = \beta_{The} \beta + {}_1 X + \beta_2 X^2$) or third-degree parabolic models ($Y = \beta_{The} \beta + {}_1 X + \beta_2 X^2 \beta + {}_3 X^3$) were built for each of the 16 municipalities and for Marajó globally, totaling 306 models, of which 96 were selected. The model with a greater coefficient of determination (R^2) and a lower descriptive level (*p*-value) and that met the assumptions of the residuals analysis (absence of outliers, normality, and independence) was considered the best model. The residual analysis was conducted for only selected models from the descriptive level ($p < 0.05$). When two models were similar from the statistical point of view for the same location, the simpler model was chosen (parsimonious).

The year 2015 was not used for the historic series of prenatal consultation indicators (numerator) and infant mortality (denominator) due to incompleteness of the SINASC data from that year. The linear and polynomial regression models for the time series were generated using *SPSS* version 20.0 and are presented as charts created using *Excel software* 2007.

Results

The monitoring indicators of primary care selected for this study in Marajó showed trends toward improvement. The MPBP was the milestone, implanted in the region in October 2013 with the arrival of physicians in the municipalities, with complete OPAS/OMS-Brazil-Cuba cooperation.

Using 12/2011 as a base, when there were 18 teams of the FHS in 10 municipalities of Marajó, with 10.9% coverage, there was reduction to 7.1% in 12/2012. From 10/2013, with the arrival of the first MPBP physicians, the number of teams increased to 38 teams and 22.9% coverage in 12/2013, to 74 teams and 42.4% coverage in 12/2014 and to 76 teams and 42.8% coverage in 12/2015, thus presenting a growing trend (Graphic 1A and Table 1). By 04/2014, all 16 municipalities had medical teams. The population coverage offered by primary care teams in the FHS grew in all municipalities of the Marajó health region in the studied period (Table 1 and Graphic 1A), but only five demonstrated coverage of more than 50%.

During that period, the monthly average in Marajó was 173 hospitalizations per CSAP for a population estimated at 533,397 inhabitants. Table 2 shows the small rate of hospitalizations in the municipalities. The ICSAP is a result indicator and presented a declining trend from the first half of 2014 in Marajó (Graphic 1B and Table 2) and in the majority of its municipalities (Table 2). Some models had no statistical significance, and a few municipalities presented increasing trends, such as Anajás, Chaves and Melgaço, with statistically significant models.

When assessing the proportion of live births to mothers with/without prenatal consultations, a growing trend was identified in most municipalities (Table 3), where seven or more consultations were predominant, with an average increase of 97% for the Marajó region (Table 3 and Graphic 1C), where Portel (80.8%), Santa Cruz do Arari (71.1%) and São Sebastião da Boa Vista (51.6%) are highlighted. In parallel, decline or stabilization occurred in the trend of the ratio of live births to mothers with four to six consultations (Table 3 and Graphic 1D), and a downward trend of the proportion of live births to mothers with no prenatal consultations occurred in most municipalities (Table 3 and Graphic 1E). In Table 3, it is noted that nine municipalities reduced non-access to consultations to percentages of less than 10%.

The infant mortality rate has presented a downward trend from the second half of 2014 in most Marajó municipalities and in the region as a whole (Graphic 1F and Table 4). The municipalities of Afuá, Bagre, Cachoeira do Arari, Chaves, Gurupá, Ponta de Pedras, Portel and Soure have very low mortality rates – lower than those of the Marajó region (Table 4). It was not possible to evaluate the indicator in 2015, similar to prenatal consultations ratios, due to limitations on live birth data in that year.

Discussion

The MPBP has widened the coverage of primary care assistance, placing physicians in isolated regions with shortages of professionals through its emergency provisional component. According to data published by the Ministry of Health, by March 2015, a total of 14,462 physicians had already covered the populations of 3,785 thousand municipalities, approximately 68% of the national municipalities, and 34 Indigenous Special Sanitary Districts, benefiting approximately 50 million Brazilians[16].

The riverside population in the large territorial area of Marajó, which is socially vulnerable, is isolated due to its distance from the urban centers of Pará state; due to the difficult geographic access within the archipelago itself, this population needed immediate and permanent strategic actions that ensured full rights to public health services for its inhabitants. Thus, it is believed that the MPBP fulfills its role in providing healthcare, as it has historically been difficult to provide proper medical care to locations distant from large urban centers.

It is noteworthy that rivers are the main access routes to services in this region; in many cases, it was not possible to have access to healthcare due to a lack of regular waterway transportation. After the launch of the program and its full adoption by the municipalities in 2013, the program changed the reality of 530,000 inhabitants of Marajó by continuously providing health service to them since physicians became a part of the primary care team in these locations.

The attention model based on family health favors planning activities and development of in-

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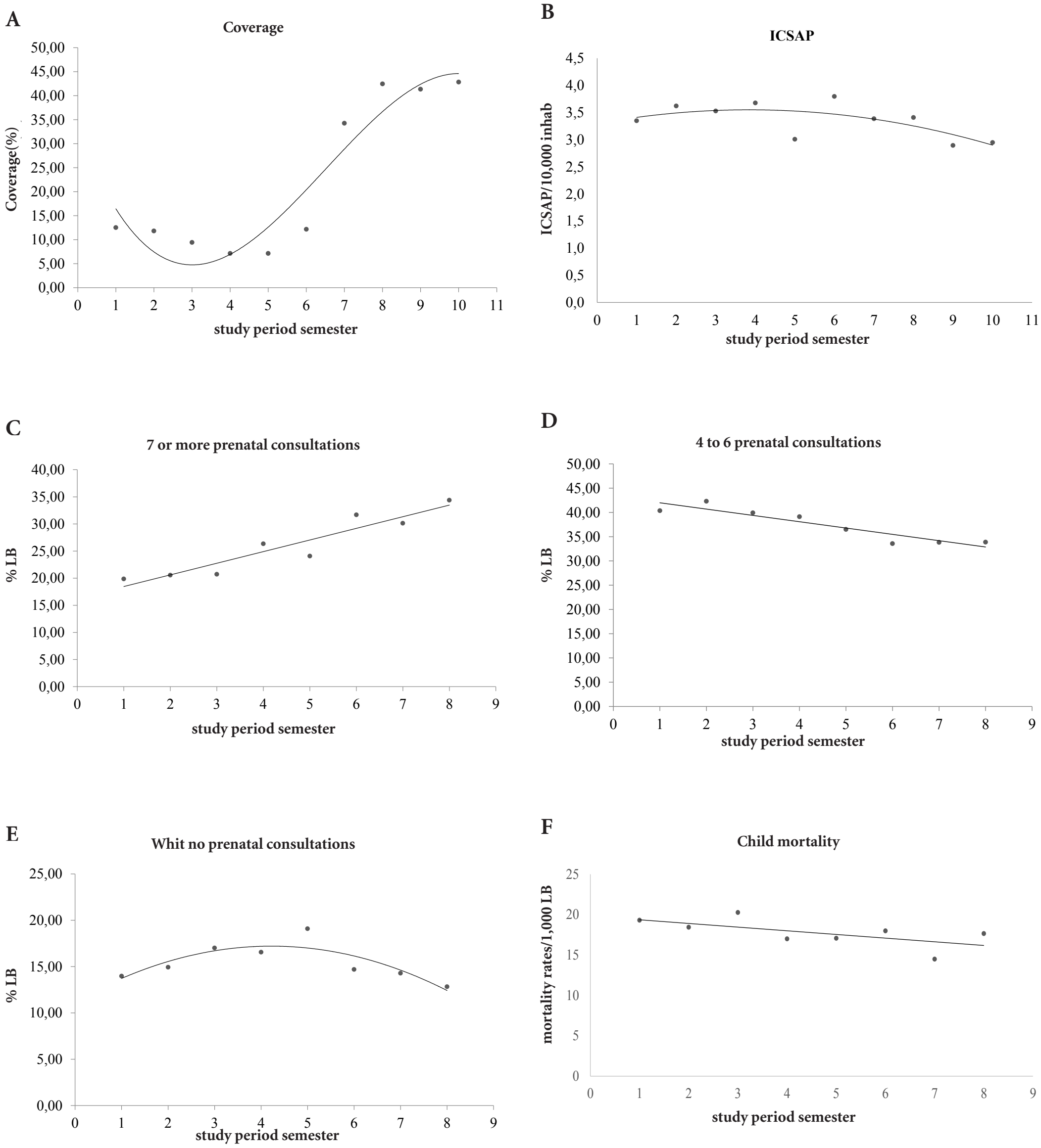

Graphic 1. Temporal trends for indicators of primary care monitoring in Marajó, 2011 to 2014/2015, per semester.

Notes: A) Population coverage estimated by primary care teams in the FHS. B) ICSAP per 10,000 inhabitants. C) Proportion of live births to mothers with seven or more prenatal consultations. D) Proportion of live births to mothers with 4 to 6 prenatal consultations. E) Proportion of live births to mothers with no prenatal consultation. F) Child mortality rate per 1,000 live births. X-axis numbering represents semesters, 1 = first half of 2011, 2 = second half of 2011, etc. until 2014 or 2015.

tersectoral actions, prioritizing universal access, qualified listening and referral, aimed at the resolution of the required demands and accountability and connections between health professionals and users[17]. This approach certainly impacts both the broadening of access and the adherence to treatment, consequently qualifying the service and increasing the capability of resolution.

This fact was observed in the present study; the evaluation of the historic series of selected indicators revealed that most municipalities presented increases in population coverage and in

Table 1. Regression models and trend for the population coverage estimated by primary care teams in the FHS in the period from 2011 to 2015 and coverage in the second half of 2015 in the municipalities of the Marajó Health Region.

Municipality	Model*	R^2_a**	P***	Trend	Coverage (%)
MARAJÓ	**$y = -0.232x^3 + 4.534x^2 - 20.960x + 33.101$**	**0.85**	**0.002**	**Ascending**	**42.8**
Afuá	$y = 2.074x - 4.807$	0.73	0.001	Ascending	14.7
Anajás	$y = 2.770x + 4.793$	0.43	0.024	Ascending	32.7
Bagre	$y = -0.428x^3 + 7.960x^2 – 37.850x + 62.093$	0.82	0.003	Ascending	49.5
Breves	$y = -0.150x^3 + 3.050x^2 - 14.681x + 23.380$	0.89	0.001	Ascending	31.6
Cachoeira do Arari	$y = -0.349x^3 + 6.465x^2 – 28.823x + 43.377$	0.65	0.026	Ascending	49.0
Chaves	$y = 1.529x^2 – 7.702x + 15.073$	0.75	0.003	Ascending	75.3
Curralinho	$y = -0.336x^3 + 5.851x^2 – 23.871x + 26.433$	0.92	0.000	Ascending	37.2
Gurupá	$y = 0.564x^2 – 1.635x + 2.980$	0.87	0.000	Ascending	38.0
Melgaço	$y = 1.496x^2 – 10.954x + 28.375$	0.76	0.003	Ascending	56.8
Muaná	$y = -0.382x^3 + 6.591x^2 – 26.105x + 31.830$	0.79	0.006	Ascending	47.4
Ponta de Pedras	$y = -0.234x^3 + 4.689x^2 – 22.325x + 33.193$	0.73	0.012	Ascending	41.2
Portel	$y = -0.245x^3 + 4.954x^2 - 25.234x + 44.757$	0.79	0.006	Ascending	41.2
Salvaterra	$y = 0.762x^2 – 6.803x + 44.698$	0.67	0.008	Ascending	53.6
Santa Cruz do Arari	$y = -0.569x^3 + 9.819x^2 – 38.507x + 34.983$	0.89	0.001	Ascending	63.7
São Sebastião Boa Vista	$y = 10.115x – 28.400$	0.73	0.001	Ascending	71.5
Soure	$y = -0.199x^3 + 4.112x^2 – 22.028x + 59.853$	0.80	0.005	Ascending	49.4

* Model: y = indicator and x = semester; **Adjusted coefficient of determination; *** Statistical significance using ANOVA.

Table 2. Regression models and trends for ICSAP in the period from 2011 to 2015 and ICSAP per 10,000 inhabitants in the second half of 2015 in the municipalities of the Marajó Health Region.

Municipality	Model*	R^2_a**	P***	Trend	ICSAP (/10.000)
MARAJÓ	**$y = -0.0172x^2 + 0.1322x + 3.2955$**	**0.32**	**0.109**	**Descending**	**2.9**
Afuá	$y = -0.0375x^3 + 0.6676x^2 - 3.5719x + 8.0717$	0.70	0.017	Descending	1.7
Anajás	$y = 0.0246x^2 - 0.185x + 0.6219$	0.72	0.005	Ascending	1.4
Bagre	$y = -0.0176x^2 + 0.2351x - 0.159$	0.11	0.280	Descending	0.4
Breves	$y = -0.0863x^2 + 0.9408x + 5.7197$	-0.12	0.608	Descending	7.0
Cachoeira do Arari	$y = -0.4246x + 5.4135$	0.69	0.002	Descending	1.3
Chaves	$y = 0.0223x^2 - 0.1733x + 0.289$	0.52	0.032	Ascending	0.6
Curralinho	$y = 0.0269x^3 - 0.3842x^2 + 1.2201x + 5.8333$	-0.40	0.500	Stable	6.7
Gurupá	$y = -0.1857x + 4.8464$	0.02	0.314	Descending	2.1
Melgaço	$y = 0.1157x^2 - 0.8361x + 3.0435$	0.68	0.008	Ascending	6.6
Muaná	$y = -0.0239x + 3.0263$	-0.12	0.826	Stable	3.5
Ponta de Pedras	$y = -0.047x^3 + 0.6674x^2 - 1.5903x + 2.2822$	0.61	0.035	Descending	6.2
Portel	$y = -0.1299x^2 + 1.1275x + 3.2378$	0.58	0.019	Descending	1.6
Salvaterra	$y = -0.1119x + 2.218$	0.26	0.077	Descending	1.1
Santa Cruz do Arari	$y = -0.0744x^2 + 0.8147x + 0.8694$	0.49	0.040	Descending	1.6
São Sebastião da Boa Vista	$y = -0.3326x + 4.6303$	0.75	0.001	Descending	1.4
Soure	$y = -0.0762x^2 + 0.764x + 0.968$	0.19	0.201	Descending	1.0

* Model: y = indicator and x = semester; ** Adjusted coefficient of determination; *** Statistical significance using ANOVA.

the number of prenatal consultations between the years 2013 and 2014, the launch and deployment periods of MPBP in the region, with relatively constant declines in hospitalization rates due to primary care sensitive conditions and infant mortality rates in the same period. As process indicators, the coverage and the number of prenatal consultations represent patterns of as-

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Table 3. Regression models and trends for the indicators of live birth (LB) proportions according to the number of prenatal consultations in the period from 2011 to 2014 in the municipalities of the Marajó Health Region.

Municipality	Model*	R^2_a**	P***	Trend	% LB
Proportion of live births to mothers with 7 or more prenatal consultations					
MARAJÓ	**$y = 2.144x + 16.326$**	**0.86**	**0.001**	**Ascending**	**34.4**
Afuá	$y = 0.338x^2 - 1.800x + 15.617$	0.45	0.097	Ascending	23.1
Anajás	$y = -0.256x^3 + 3.484x^2 - 12.086x + 23.153$	0.40	0.191	Ascending	17.2
Bagre	$y = -0.064x^3 + 0.832x^2 - 1.838x + 10.149$	0.29	0.266	Ascending	17.2
Breves	$y = 0.177x^3 - 2.231x^2 + 8.019x + 8.165$	0.74	0.038	Ascending	20.5
Cachoeira do Arari	$y = 3.145x + 22.763$	0.73	0.004	Ascending	48.1
Chaves	$y = 1.272x + 2.740$	0.59	0.015	Ascending	10.4
Curralinho	$y = 2.359x + 15.852$	0.55	0.021	Ascending	40.9
Gurupá	$y = 0.250x^3 - 2.780x^2 + 8.277x + 8.539$	0.60	0.088	Ascending	26.0
Melgaço	$y = -4.038x + 40.994$	0.80	0.002	Descending	13.5
Muaná	$y = 0.416x^2 - 5.298x + 54.384$	0.31	0.169	Descending	38.3
Ponta de Pedras	$y = -0.017x^3 + 0.418x^2 - 2.722x + 36.950$	-0.54	0.900	Stable	34.1
Portel	$y = 12.760x – 9.123$	0.81	0.001	Ascending	80.1
Salvaterra	$y = -0.862x^2 + 9.687x + 11.561$	0.34	0.154	Ascending	37.9
Santa Cruz do Arari	$y = 9.891x – 3.644$	0.77	0.002	Ascending	60.9
São Sebastião da Boa Vista	$y = 3.227x + 27.831$	0.83	0.001	Ascending	58.3
Soure	$y = -0.184x^3 + 2.639x^2 - 10.217x + 44.056$	-0.10	0.487	Stable	37.7
Proportion of live births to mothers with 4 to 6 prenatal consultations					
MARAJÓ	**$y = -1.302x + 43.292$**	**0.84**	**0.001**	**Descending**	**33.9**
Afuá	$y = 0.116x^3 - 1.796x^2 + 7.575x + 29.714$	0.30	0.253	Descending	34.3
Anajás	$y = 0.201x^3 – 2.357x^2 + 7.435x + 34.404$	0.56	0.109	Ascending	46.2
Bagre	$y = 0.135x^2 + 0.336x + 51.207$	0.17	0.274	Descending	44.4
Breves	$y = 0.237x^3 - 3.077x^2 + 10.139x + 32.284$	0.46	0.160	Descending	36.9
Cachoeira do Arari	$y = -1.782x + 52.186$	0.42	0.048	Descending	36.3
Chaves	$y = 0.217x^3 - 2.888x^2 + 11.854x + 12.427$	0.38	0.207	Ascending	35.0
Curralinho	$y = -0.472x^3 + 5.973x^2 - 20.873x + 60.975$	0.74	0.041	Descending	34.7
Gurupá	$y = 0.256x^3 - 2.733x^2 + 6.708x + 33.211$	0.69	0.056	Ascending	41.9
Melgaço	$y = 0.358x^3 - 5.981x^2 + 29.987 – 4.544$	0.68	0.059	Ascending	36.2
Muaná	$y = 0.2201x^2 - 1.7735x + 44.26$	-0.25	0.747	Stable	46.6
Ponta de Pedras	$y = 0.124x^3 - 1.802x^2 + 7.732x + 36.243$	-0.55	0.912	Stable	46.5
Portel	$y = 0.263x^3 - 3.375x^2 + 5.364x + 40.089$	0.73	0.043	Descending	01.5
Salvaterra	$y = -2.737x + 61.163$	0.70	0.006	Descending	41.6
Santa Cruz do Arari	$y = -3.6656x + 45.86$	0.17	0.169	Descending	27.7
São Sebastião da Boa Vista	$y = -0.210x^3 + 2.970x^2 - 14.284x + 66.260$	0.91	0.005	Descending	34.1
Soure	$y = -0.094x^3 + 1.182x^2 - 4.622x + 49.457$	-0.23	0.668	Stable	40.3
Proportion of live births to mothers with no prenatal consultation					
MARAJÓ	**$y = -0.336x^2 + 2.835x + 11.221$**	**0.62**	**0.039**	**Descending**	**12.8**
Afuá	$y = -1.131x + 17.091$	0.37	0.064	Descending	7.3
Anajás	$y = 0.068x^3 - 1.881x^2 + 10.949x + 6.719$	0.55	0.114	Descending	9.6
Bagre	$y = -0.279x^3 + 3.617x^2 - 12.400x + 30.500$	0.49	0.441	Descending	20.6
Breves	$y = -0.355x^2 + 3.802x + 12.100$	0.58	0.049	Descending	19.3
Cachoeira do Arari	$y = -0.0399x^3 + 0.5217x^2 - 1.8925x + 6.934$	-0.59	0.937	Stable	04.2
Chaves	$y = -1.544x + 34.175$	0.73	0.004	Descending	19.5
Curralinho	$y = 0.463x^3 - 6.359x^2 + 23.269x - 3.036$	0.94	0.002	Descending	12.7
Gurupá	$y = -0.486x^3 + 5.006x^2 - 9.725x + 16.169$	0.76	0.035	Descending	12.3
Melgaço	$y = 1.569x + 7.214$	0.67	0.008	Descending	16.6
Muaná	$y = -0.153x^2 + 1.060x + 3.045$	0.32	0.165	Descending	02.1
Ponta de Pedras	$y = 0.0682x^3 - 1.0331x^2 + 4.2643x + 0.7968$	-0.42	0.815	Stable	03.9
Portel	$y = 0.438x^3 -6.144x^2 + 22.180x + 7.584$	0.65	0.068	Descending	16.4
Salvaterra	$y = -0.105x^2 + 1.412x + 0.105$	0.58	0.048	Descending	04.0
Santa Cruz do Arari	$y = 0.510x^3 - 7.469x^2 + 29.336x - 9.406$	0.74	0.040	Descending	07.5
São Sebastião da Boa Vista	$y = -0.019x^3 + 0.219x^2 – 0.762x + 3.611$	0.48	0.147	Descending	01.8
Soure	$y = 0.091x^3 - 1.137x^2 + 5.478x – 2.682$	-0.03	0.506	Stable	03.1

* Model: y = indicator and x = semester; ** Adjusted coefficient of determination; *** Statistical significance using ANOVA.

Table 4. Regression models and trends for child mortality rate per 1000 live births (LB) in the period from 2011 to 2014 and rates in the second half of 2014 in the municipalities of the Marajó Health Region.

Municipality	Model*	R^2_a**	p***	Trend	Rate/1000 LB
MARAJÓ	**y = -0.454x + 19.817**	**0.32**	**0.086**	**Descending**	**17.7**
Afuá	$y = 0.345x^3 - 4.573x^2 + 15.566x + 5.406$	-0.08	0.547	Descending	13.9
Anajás	$y = 0.221x^2 - 0.949x + 14.270$	-0.05	0.487	Ascending	23.3
Bagre	$y = 0.613x^2 - 7.147x + 30.190$	-0.01	0.443	Descending	08.1
Breves	$y = 0.285x^3 - 3.849x^2 + 14.021x + 8.214$	0.55	0.111	Descending	20.1
Cachoeira do Arari	$y = -0.717x^3 + 9.708x^2 - 38.251x + 61.825$	-0.30	0.724	Descending	12.5
Chaves	y = -2.766x + 34.662	0.40	0.056	Descending	16.4
Curralinho	$y = 1.135x^2 - 11.304x + 41.396$	0.38	0.131	Descending	21.6
Gurupá	$y = -0.774x^2 + 8.090x – 2.768$	0.28	0.191	Ascending	11.2
Melgaço	$y = 0.722x^3 - 9.492x^2 + 34.282x - 13.408$	0.36	0.218	Descending	24.0
Muaná	$y = -0.098x^3 + 0.743x^2 + 0.406x + 20.624$	-0.53	0.896	Ascending	25.3
Ponta de Pedras	y = -3.827x + 35.009	0.42	0.050	Descending	05.2
Portel	$y = -0.409x^3 + 5.729x^2 - 24.010x + 46.554$	-0.04	0.513	Descending	13.3
Salvaterra	$y = -0.350x^2 + 5.582x + 7.563$	0.11	0.320	Ascending	33.0
Santa Cruz do Arari	y = 6.696x - 17.113	0.20	0.150	Ascending	20.8
São Sebastião da Boa Vista	$y = 0.710x^3 - 8.786x^2 + 28.263x - 2.273$	0.19	0.335	Ascending	19.6
Soure	$y = -0.356x^3 + 3.742x^2 - 7.468x + 16.525$	0.52	0.130	Descending	13.8

* Model: y = indicator and x = semester; ** Adjusted coefficient of determination; *** Statistical significance using ANOVA.

sistance sensitive to changes in attention to short term health care[8] and demonstrated growing trends in the study, suggesting advances in primary care in the studied region.

Reorganization of the prenatal care in Brazil met a milestone in the creation of the Humanization of Prenatal Care and Birth Program (Programa de Humanização do Pré-natal e Nascimento - PHPN) in 2001. An initial assessment two years after its implementation revealed that only 20% of women had access to six or more prenatal consultations, which was the recommendation at that time[18]. Considering the continuing high rates of maternal and child mortality, in 2011, the Ministry of Health, in accordance with the PHPN, established the Stork Network[19], implemented in Marajó in 2012 by the State Action Plan[20]. Despite these government initiatives, it was only after PMMB that the percentage of women in Marajó who had seven or more prenatal consultations was greater than 30% and that the percentage of those who had no consultations decreased to 12.8%.

It is important to stress that such changes began at the end of 2013 and in the first half of 2014, in which the region's municipalities experienced strong ascending trends in the number of prenatal consultations, reaching the level of seven or more consultations, as recommended by the Stork Network strategy[19]. This change demonstrated advances in the implementation of the network in the region, although data from 2015 have not been analyzed in this study, when the program would have been in place for more than one year. It was also observed that municipalities with very low Human Development Indexes (HDIs), such as Melgaço (0.418), Chaves (0.453), Bagre (0.471) and Anajás (0.484), did not reach the 20% level of access to seven prenatal consultations, with the exception of Afuá (0.489) and Portel (0.483), which, despite having HDIs at the same level, reached 23.1% and 80.1%, respectively.

The difference between Portel and the other municipalities in the region may be associated with issues of municipal health policy management, which remains sTable, despite changes in municipal executives as a consequence of elections. Even without being able to simplify the improvement of this indicator due to management, a possible relationship is observed between the change in the structure of the primary care, with funding and skilled professionals provided by MPBP, and efficient management, promoting improvements in prenatal care processes.

Two result indicators were evaluated: infant mortality rate and ICSAP. Even though the follow-up time after MPBP implementation has

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been short, it was possible to observe downward trends for these rates for most municipalities of Marajó. The downward trend of infant mortality associated with the increase in population coverage suggests the importance of the program in regards to preventive care through integrated educational actions and welfare services, considering the primary role of the organization of services in FHS: producing health care.

The present study corroborates the results reported by Macinko et al.[21] in an ecological study that included 537 microregions in Brazil, in which, after controlling other determinants of health, noted that a 10% increase in FHS coverage led to a 0.45% decrease in the infant mortality rate. The present study also corroborates the results reported by Lourenço et al.[22], who highlighted a downward trend in infant mortality concurrent with the increased coverage of the FHS in the state of Sao Paulo.

Despite the downward trend, the Marajó region presented infant mortality higher than that of Pará state: 15.7/1000 live births in 2014. The limitations of vital statistics are present in mortality studies; extremely low rates do not necessarily mean reduced infant mortality but can be a consequence of under-reporting of live births and deaths resulting from the isolation of riverside communities. It is also important to consider other explanatory milestones to uncover the trends presented by these indexes, including their relationship with the socioeconomic context, environmental and cultural contexts, availability of resources, available structures and organizational arrangements.

The MPBP has resulted in changes in the work processes of the FHS, including changes to the management and control models used in the region, introducing a new actor in the process: the universities, with an alternate viewpoint and elements for discussion between management and teams. These factors must be considered to explain the decreasing trend in ICSAP rates that coincided with the period following the implementation of the program in the region. However, the interpretation of this indicator requires caution because health problems that were hidden can be identified when there is better access to quality healthcare; thus, the decrease was not uniform and remained high in the municipalities with lower HDIs.

Asaria et al.[23] analyzed the ICSAP in communities in England and noted that despite growing evidence regarding the effectiveness of investing in primary care to reduce hospitalizations, issues regarding lifestyle and socioeconomic situation also influenced these hospitalizations. In this sense, in isolated Marajó communities, in municipalities with very low HDIs, the increase in primary care access may have revealed situations of advanced-stage disease that required hospitalization or had referrals from physicians for hospitalization.

The number of studies that use ICSAP as a tool for evaluating primary care has increased in recent years, demonstrating that investment in this area of healthcare positively influences reductions in morbidity and hospital admissions, contributing to improving the health conditions of the community[10,24]. One of the limitations on the use of hospital diagnostics involves classification errors imposed by improper ICD-10 encoding. To minimize this error, the hospital discharge code was used in the study, which is supposedly more suiTable for being recorded after hospitalization.

The performance evaluation of implemented programs allows for the monitoring of effects in the communities in which the programs have been offered, especially related to reductions in health iniquities, providing elements to management for planning in the short and long term. The use of secondary data, such as in this study, enables the incorporation of information from health conditions in a manner that is relatively quick, simple and broadly accessed. The results indicated the contribution of MPBP towards improving primary care based on the selected indicators, boosting the FHS in the Marajó region. More follow-up will be important for elucidating conclusions, considering the evolution of health programs in the studied region.

Collaborations

VB Carneiro worked on designing, collecting and analyzing the data, preparing and writing the article. MSCB Bastos worked on the design, data analysis and final writing of the article. EMLS Ramos worked on statistical analysis of the data and writing of the article. CR Maia worked in the bibliographical research and writing of the article.

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