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ORIGINAL ARTICLE

Assessment of social and health indicators in municipalities of Minas Gerais according to the rural-urban typology

Avaliação de indicadores sociais e de saúde em municípios de Minas Gerais conforme tipologia rural-urbano

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ABSTRACT This article aims to evaluate social and health indicators of municipalities according to the rural-urban typology. This is an ecological study that used official publicly accessible data from the 853 municipalities in the state of Minas Gerais, Brazil. Descriptive and bivariate analysis were carried out using Poisson Regression and Kruskal-Wallis Test. 547 (64.12%) are rural municipalities. The highest average of the Municipal Human Development Index (MHDI) was observed among urban municipalities. The highest average coverage of the Family Health Strategy (FHS) was found among rural municipalities. In these municipalities, the best results were shown for the indicators of infant mortality, premature mortality and mortality from preventable causes, vaccine homogeneity and prevalence of malnutrition. The findings of this study show that greater FHS coverage is associated with the occurrence of better general living and health conditions in the populations served in rural municipalities. It is recommended that health managers encourage the consolidation of the FHS in communities with unfavorable socioeconomic and cultural contexts, such as remote rural locations and urban agglomerations, and the establishment of intersectoral actions with a positive impact on health.

KEYWORDS Primary Health Care. Health status indicators. Social indicators. Urban area. Rural areas.

RESUMO *O presente artigo tem o objetivo de avaliar indicadores sociais e de saúde de municípios conforme a tipologia rural-urbano. Trata-se de estudo ecológico que utilizou dados oficiais de acesso público dos 853 municípios do estado de Minas Gerais, Brasil. Foram conduzidas análises descritivas e bivariadas através da Regressão de Poisson e Teste de Kruskal-Wallis. Do total de municípios, 547 (64,12%) são rurais. A maior média do Índice de Desenvolvimento Humano Municipal (IDH-M) foi observada entre os municípios urbanos. A maior média de cobertura da Estratégia Saúde da Família (ESF) foi verificada entre os municípios rurais, nos quais também foram demonstrados os melhores resultados para os indicadores de mortalidades infantil, prematura e por causas evitáveis, homogeneidade vacinal e prevalência de desnutrição. Os achados deste estudo evidenciam que uma maior cobertura da ESF está associada à ocorrência de melhores condições gerais de vida e de saúde das populações atendidas em municípios de tipologia rural. Recomenda-se aos gestores de saúde o fomento à consolidação da ESF em comunidades com contextos socioeconômicos e culturais desfavoráveis, como localidades rurais remotas e aglomerados urbanos, e o estabelecimento de ações intersetoriais com impacto positivo na saúde.*

PALAVRAS-CHAVE *Atenção Primária à Saúde. Indicadores básicos de saúde. Indicadores sociais. Área urbana. Zona rural.*

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Introduction

In Brazil, rural populations commonly have low education[1], low income[1,2], less access to health services and greater vulnerability to health risk factors[3,4]. Previous studies indicate that the different stages of socioeconomic development between urban and rural areas in Brazil contribute to inequality in access to basic and essential items for quality of life, such as sanitation and treated water, which makes the health of rural populations more precarious compared to urban populations[4,5].

Primary Health Care (PHC) has expanded and consolidated in Brazil in recent years, mainly due to the process of decentralization and expansion of care coverage driven by the Family Health Strategy (FHC)[6,7]. However, despite advances, the old challenges to the consolidation of PHC still persist, such as insufficient funding, the distribution of professionals and the need for improvements in access, quality and effectiveness of the services offered[8,9].

In the history of expansion and consolidation of PHC in Brazil, two important elements stand out, which may be related to the quality of care in the extensive national territory: the great expansion of care coverage from the 2000s onwards, with different rhythms between the regions and population size of municipalities[10,11] and the low care performance of the ESF in rural areas[12].

Access to healthcare is considered one of the essential determinants of quality of life and socioeconomic development, with impacts on mortality and life expectancy. Additionally, access to health influences several aspects of the social life of populations, such as demographic dynamics related to the need to travel in search of access to health services, with impacts on mortality and life expectancy of vulnerable individuals[5]. Therefore, ensuring access to health services for all Brazilian citizens is still a major challenge for the Unified Health System (SUS), especially for populations living in rural areas[4,13].

According to the geographic classification of Brazilian municipalities, carried out by the Brazilian Institute of Geography and Statistics (IBGE) in 2017, more than 64% of Minas Gerais municipalities are rural[14]. This scenario points to interesting opportunities to evaluate certain attributes and dimensions of the population's health status and the performance of the health system in Minas Gerais municipalities according to the rural-urban typology proposed by IBGE. It is noteworthy that such an assessment could contribute to the definition of public policies aimed at reducing local-regional inequities in the state. Therefore, this study aims to evaluate social and health indicators in municipalities in the state of Minas Gerais according to the rural-urban typology.

Material and methods

This is an ecological study[15] that covers the municipalities of Minas Gerais. The state, whose capital is Belo Horizonte, is one of the 27 states in Brazil, being the fourth largest in territorial extension (586,528 km^2) and the second most populous, with an estimated population for 2020 of 21,292,666 inhabitants[16]. The state has 853 municipalities, divided into 12 mesoregions[16], 14 health macro-regions and 89 health micro-regions[17].

Minas Gerais is characterized by having a large territorial extension[17], a predominance of small and medium-sized municipalities[17] and by presenting evident socioeconomic disparities between the mesoregions[18]. Regarding the economic aspect, the state presents a great diversification of economic activities between the mesoregions, with a concentration of important industrial centers in the Central and South mesoregions, while, in the North and Jequitinhonha mesoregions, activities linked to the primary

segment of the economy stand out, such as mineral extraction, extensive livestock farming and subsistence agriculture[18]. The state has the municipality with the smallest population among the municipalities in Brazil, Serra da Saudade (815 inhabitants), while the metropolitan region of Belo Horizonte has around 5 million inhabitants[17].

Data collection was carried out from March to May 2021, in official publicly accessible databases. Data were collected regarding 15 variables about the municipalities and, subsequently, these variables were grouped into 4 thematic blocks, according to their type: rural-urban typology, geographic location, social indicators and health indicators. *Box 1* contains details of the variables studied, including their grouping into thematic blocks, the year of reference, the source, the date of access, the concept and the cut-off point used in the categorization.

Box 1. Variables by thematic blocks: rural-urban typology, geographic location, social indicators and health indicators of municipalities in the state of Minas Gerais, Brazil

Thematic block	Variable	Year of reference	Source	Concept	Cut-off point for categorization
Rural-urban typology	Municipal typology	2017	IBGE. https://www.ibge.gov.br Accessed on 08/03/2021.	Classification of Brazilian municipalities into 5 typologies: Urban, Intermediate Adjacent, Intermediate Remote, Rural Adjacent and Rural Remote.	Not applicable
Geographic location	Municipality	2019	IBGE. https://www.ibge.gov.br Accessed on 07/03/2021.	Autonomous unit of lowest hierarchy in the political-administrative organization of Brazil, as defined by IBGE in the Brazilian Territorial Division (DTB).	Not applicable
	Health Macroregion	2020	PDR/MG. https://www.saude.mg.gov.br Accessed on 07/03/2021.	Territorial basis for planning tertiary health care. It has a population of around 700 thousand inhabitants.	Not applicable
	Health Microregion	2020	PDR/MG. https://www.saude.mg.gov.br Accessed on 07/03/2021.	Territorial basis for planning secondary health care. Set of contiguous municipalities, with a population of around 100 thousand inhabitants, attached to a hub municipality.	Not applicable
Social indicators	Population	2018	IBGE. https://www.ibge.gov.br Accessed on 11/04/2021.	Estimate of the number of inhabitants of the municipality (TCU).	1. Large: Municipalities with 100 thousand inhabitants or more. 2. Small/Medium Size: Municipalities with less than 100 thousand inhabitants.
	Municipal Human Development Index (MHDI)	2010	AtlasBR. http://www.atlasbrasil.org.br Accessed on 29/03/2021.	Measure composed of indicators of longevity, education and income. It ranges from 0 to 1. Values close to 1 indicate high development.	State MHDI (MG, 2010): 0.731. 1. Equal to/above the State MHDI. 2. Below the State MHDI.
	Gini Index	2010	AtlasBR. http://www.atlasbrasil.org.br Accessed on 29/03/2021.	Degree of income concentration, whose value varies from 0 (perfect equality) to 1 (maximum inequality).	State Gini (MG, 2010): 0.56. 1. Equal to/below the state index. 2. Above the state index

Box 1. Variables by thematic blocks: rural-urban typology, geographic location, social indicators and health indicators of municipalities in the state of Minas Gerais, Brazil

Thematic block	Variable	Year of reference	Source	Concept	Cut-off point for categorization
Health indicators	Estimated FHS Population Coverage	2018 (July)	e-Gestor AB. https://egestorab.saude.gov.br Accessed on 14/04/2021.	Percentage of population coverage by FHS teams (3000 inhabitants/team).	State FHS coverage (MG, July/2018): 80.15%. 1. Equal/above state coverage. 2. Below state coverage.
	Infant Mortality Rate	2018	SES/MG. http://vigilancia.saude.mg.gov.br Accessed on 10/04/2021.	Number of deaths of children under one year of age, per 1000 live births, in the resident population, in the year considered.	State rate (MG, 2018): 10.96. 1. Equal to/below the state rate. 2. Above the state rate.
	Proportion of Hospitalizations for PHC-Sensitive Conditions (ICSAP)	2018	SES/MG. https://www.saude.mg.gov.br Accessed on 15/05/2021.	Proportion between the number of hospitalizations for selected causes sensitive to PHC and the total number of clinical hospitalizations, by place of residence and year of hospitalization.	State ICSAP (MG, 2018): 40.73%. 1. Equal to/below the state ICSAP. 2. Above the state ICSAP.
	Proportion of live births to mothers with 7 or more prenatal consultations	2018	SES/MG. https://www.saude.mg.gov.br Accessed on 15/05/2021.	Proportion between the number of live births to mothers residing in a location and year with 7 or more prenatal consultations and the number of live births to mothers residing in the same location and period.	State target (MG, 2018): Greater than or equal to 78%. 1. Equal to/greater than the state target. 2. Lower than the state target.
	Premature Mortality Rate from NCDs	2018	SES/MG. https://www.saude.mg.gov.br Accessed on 20/05/2021.	Number of deaths (30 to 69 years old) due to NCDs registered in specific codes / Resident population (30 to 69 years old), in a specific year and location x 100,000.	State rate (MG, 2018): 146.3. 1. Equal to/below the state rate. 2. Above the state rate.
	Proportion of OCE in Children Under Five Years of Age	2018	SES/MG. https://www.saude.mg.gov.br Accessed on 20/05/2021.	Proportion between the number of deaths of children aged 0 to 4 years from Group 1 and the number of deaths of children aged 0 to 4 years in the same location and period.	State target (MG, 2018): 61.30%. 1. Equal to/below the state target. 2. Above the state target.
	Prevalence of Malnutrition in Children Under 2 Years of Age	2018	SES/MG. https://www.saude.mg.gov.br Accessed on 23/05/2021.	Number of children up to 2 years old with malnutrition monitored by SISVAN / total number of children up to 2 years old monitored by SISVAN x 100.	State target (MG, 2018): 4.82%. 1. Equal to/below the state target. 2. Above the state target.
	Percentage of Vaccine Homogeneity	2018	SES/MG. https://www.saude.mg.gov.br Accessed on 25/05/2021.	Number of related vaccines that reached the recommended target / number of related vaccines x 100.	State target (MG, 2018): 70%. 1. Equal to/above the state target. 2. Below the state target.

Source: Own elaboration.

AtlasBR: Atlas of Human Development in Brazil; NCD: Chronic Noncommunicable Diseases; e-Gestor AB: Primary Care Information and Management Platform; FHC: Family Health Strategy; Group 1: Group 1 of the List of Causes of Deaths Preventable by SUS Intervention; IBGE: Brazilian Institute of Geography and Statistics;OCE: Deaths from Preventable Causes; PDR/MG: Minas Gerais Health Regionalization Master Plan; SES/MG: State Department of Health of Minas Gerais; Sisvan: Food and Nutrition Surveillance System; SUS: Unified Health System.

The variable Rural-Urban Typology refers to the geographic classification of municipalities into five typologies: Urban, Intermediate Adjacent, Intermediate Remote, Rural Adjacent and Rural Remote, based on the methodology developed by IBGE[14], which considers three criteria: population in areas of dense occupation; proportion of population in areas of dense occupation in relation to the total population; and location. The municipalities of the Adjacent Intermediate and Remote Intermediate typologies were grouped into a single typology, called Intermediate. In turn, municipalities belonging to the Remote Rural and Adjacent Rural typologies were grouped into the Rural typology.

The variable Infant Mortality Rate (IMR) was accessed on the Health Surveillance Portal of the State Department of Health of Minas Gerais (SES/MG), Municipal Situation Room, and referred to the year 2018 (*box 1*). According to the methodology adopted by the Superintendency of Epidemiological Surveillance of SES/MG, for municipalities with a population greater than or equal to 100,000 inhabitants, the IMR was adopted, while for the other municipalities the absolute number was used.

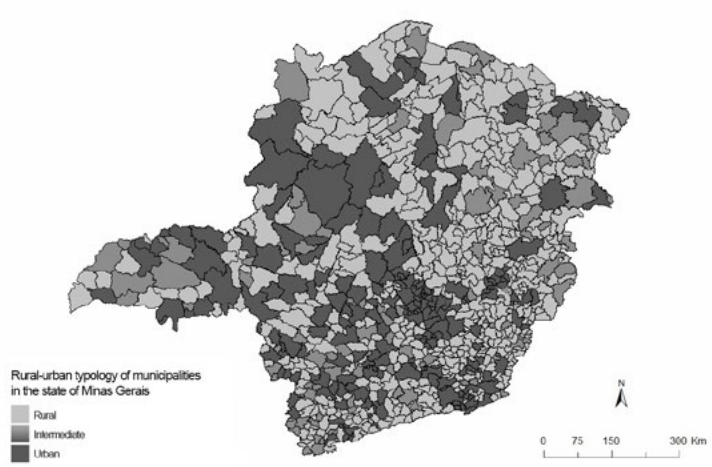
For data analysis, the Statistical Package For The Social Sciences (SPSS)®, Version 23, was used. The following statistical analyzes were conducted: (1) Prevalence of indicators according to geographic classification and Chi-square test to verify the occurrence of significant associations; (2) Prevalence Ratio using Poisson Regression to estimate the magnitude of associations and (3) Kruskal-Wallis test to compare indicators by municipality type. To perform the Chi-square and Poisson Regression tests, the variables were categorized (*box 1*).

The present study followed the guidelines and standards of Resolutions No 466/2012[19] and No 510/2016[20] of the National Health Council, which regulate the ethical and legal aspects of scientific research in Brazil. As this is research involving only publicly accessible data, whose information is aggregated, without the possibility of individual identification, the present study did not present in its design the direct participation of human beings and, therefore, there was no obligation to submit to an Ethics in Research Committee for consideration and analysis.

Results

Of the 853 municipalities in the state of Minas Gerais, 547 (64.12%) are classified as rural, 201 (23.56%) as urban and 105 (12.30%) as intermediate, according to the rural-urban typology. The highest proportions of municipalities classified in the urban typology occurred in the health macro-regions Center (44.55%), South Triangle (37.03%) and North Triangle (33.33%). The health macro-regions East (88.23%), East of the South (84.90%) and Jequitinhonha (83.87%) had the highest proportions of municipalities classified in the Rural typology. Finally, the macro-regions North Triangle (29.62%), Northeast (26.31%) and Northwest (18.18%) had the largest number of municipalities classified as intermediate. *Figure 1* shows the spatial distribution of rural-urban typologies in the municipalities of the state of Minas Gerais.

Figure 1. Rural-urban typology of municipalities in the state of Minas Gerais



Source: Own elaboration.

The analysis, considering social indicators in their numerical nature, found a higher average Municipal Human Development Index (MHDI) among urban municipalities (0.72) and a lower average Gini Index among intermediate and rural municipalities (0.47). In turn, the analysis of health indicators indicated that rural municipalities had higher averages for FHC Coverage (98.34%) and Vaccination Homogeneity (63.92%), and lower averages for IMR (0.98), Deaths by Preventable Causes (35.24%) and Prevalence of Malnutrition (4.35%). A lower average number of Hospitalizations for Ambulatory Care Sensitive Conditions (ICSAP) (39.24) was observed among urban municipalities (*table 1*).

Table 1. Descriptive measures of social and health indicators according to the rural-urban typology, Minas Gerais, Brazil, 2020

Variable	Typology	Average	d.p	Median	Minimum	Maximum	P-Value*
Social indicators							
MHDI	Urban[a]	0.72	0.04	0.72	0.62	0.81	0.000
	Intermediate[b]	0.68	0.04	0.68	0.58	0.75	
	Rural[c]	0.65	0.04	0.65	0.53	0.75	
	Total	0.67	0.05	0.67	0.53	0.81	
Gini Index	Urban[a]	0.48	0.05	0.48	0.35	0.68	0.048
	Intermediate[a,b]	0.47	0.06	0.47	0.34	0.68	
	Rural[b]	0.47	0.05	0.47	0.32	0.78	
		0.47	0.05	0.47	0.32	0.78	
Health indicators							
ESF coverage (%)	Urban[a]	84.67	17.53	91.26	30.21	100.00	0.000
	Intermediate[b]	93.72	13.23	100.00	40.93	100.00	
	Rural[c]	98.34	6.36	100.00	43.75	100.00	
	Total	94.55	12.32	100.00	30.21	100.00	

Table 1. Descriptive measures of social and health indicators according to the rural-urban typology, Minas Gerais, Brazil, 2020

Variable	Typology	Average	d.p	Median	Minimum	Maximum	P-Value*
Infant Mortality Rate	Urban[a]	6.06	6.54	4.00	0.00	65.00	0.000
	Intermediate[b]	1.92	1.62	2.00	0.00	7.00	
	Rural[c]	0.98	1.27	1.00	0.00	10.00	
	Total	2.29	3.98	1.00	0.00	65.00	
ICSAP (%)	Urban[a]	39.24	7.82	39.27	21.50	72.35	0.002
	Intermediate[a,b]	41.40	10.33	40.66	9.34	82.06	
	Rural[b]	42.81	12.08	41.43	12.24	85.33	
	Total	41.80	11.10	40.76	9.34	85.33	
Proportion of Live Births (%)	Urban	77.33	8.74	78.04	38.89	96.67	0.649
	Intermediate	78.25	8.71	79.57	49.06	97.06	
	Rural	77.41	10.73	78.33	37.29	100.00	
	Total	77.49	10.05	78.57	37.29	100.00	
Premature Mortality Rate	Urban	317.02	99.30	299.40	31.20	948.70	0.185
	Intermediate	318.09	90.99	302.10	134.60	649.40	
	Rural	305.26	124.51	292.80	0.00	855.50	
	Total	309.61	115.30	297.10	0.00	948.70	
Deaths from Preventable Causes (%)	Urban[a]	56.75	31.46	60.00	0.00	100.00	0.000
	Intermediate[a]	49.23	39.92	50.00	0.00	100.00	
	Rural[b]	35.24	42.89	0.00	0.00	100.00	
	Total	42.03	41.15	50.00	0.00	100.00	
Prevalence of Malnutrition (%)	Urban[a]	5.08	3.40	4.32	0.000	22.14	0.004
	Intermediate[a,b]	4.84	3.96	4.09	0.81	33.33	
	Rural[b]	4.35	3.15	3.74	0.00	19.64	
	Total	4.58	3.33	3.88	0.00	33.33	
Vaccine Homogeneity (%)	Urban[a]	44.19	34.35	35.29	0.00	100.00	0.000
	Intermediate[b]	54.73	28.72	52.94	0.00	100.00	
	Rural[c]	63.92	29.59	76.47	0.00	100.00	
		58.14	31.74	70.59	0.00	100.00	

Source: Own elaboration.

*Kruskal-Wallis test; d.p: standard deviation;

a,b,c different letters correspond to significant difference and equal letters to non-significant difference.

As for social indicators, categorically addressed, it is highlighted that 822 (96.40%) are small/medium-sized municipalities and a total of 771 municipalities (90.4%) have MHDI below the state index (0.731). In relation to health indicators, there was a higher proportion of rural municipalities with FHC coverage above state coverage (527=96.3%); higher proportion of intermediate (105=100%) and rural municipalities (547=100%) with an Infant Mortality Rate equal to/below the state rate; higher proportion of urban municipalities (117=58.2%) with ICSAP equal to/below the state level; 799 municipalities (93.7%) with a Premature Mortality Rate above the state rate; higher proportion of rural municipalities (379=69.3%) with Deaths from Preventable Causes equal to/below the state target; and a higher proportion of rural municipalities (327=59.8%) with Vaccination Homogeneity equal to/above the state target (*table 2*).

Table 2. Social and health indicators of municipalities according to rural-urban typology, Minas Gerais, Brazil, 2020

	Typology				
	Urban	Intermediate	Rural	Total	
Variable	**n(%)**	**n(%)**	**n(%)**	**n(%)**	**P-value***
Social indicators					
Population					**< 0.001**
Large size	31 (15.40)	0 (0.00)	0 (0.00)	31 (3.60)	
Medium/small size	170 (84.60)	105 (100.00)	547 (100.00)	822 (96.40)	
MIDH					**< 0.001**
Equal/above the state index	73 (36.30)	3 (2.90)	6 (1.10)	82 (9.60)	
Below the state index	128 (63.70)	102 (97.10)	541 (98.90)	771 (90.40)	
Gini Index					**0.623**
Equal/below the state index	189 (94.00)	99 (94.30)	523 (95.60)	811 (95.10)	
Above the state index	12 (6.00)	6 (5.70)	24 (4.40)	42 (4.90)	
Health Indicators					
FHC Coverage					**< 0.001**
Above state coverage	131 (65.20)	92 (87.60)	527 (96.30)	750 (87.90)	
Below state coverage	70 (34.80)	13 (12.40)	20 (3.70)	103 (12.10)	
Infant mortality rate					**< 0.001**
Equal to/below the state rate	165 (82.10)	105 (100.00)	547 (100.00)	817 (95.80)	
Above the state rate	36 (17.90)	0 (0.00)	0 (0.00)	36 (4.20)	
ICSAP					**0.019**
Equal/below the state ICSAP	117 (58.20)	52 (49.50)	255 (46.60)	424 (49.70)	
Above the state ICSAP	84 (41.80)	53 (50.50)	292 (53.40)	429 (50.30)	
Proportion of Live Births					**0.319**
Equal to/greater than the state target	101 (50.20)	62 (59.00)	284 (51.90)	447 (52.40)	
Lower than the state target	100 (49.80)	43 (41.00)	263 (48.10)	406 (47.60)	
Premature Mortality Rate					**< 0.001**
Equal to/below the state rate	4 (2.00)	1 (1.00)	49 (9.00)	54 (6.30)	
Above the state rate	197 (98.00)	104 (99.00)	498 (91.00)	799 (93.70)	
Deaths from Preventable Causes					**< 0.001**
Equal/below the state target	108 (53.70)	62 (59.00)	379 (69.30)	549 (64.40)	
Above the state target	93 (46.30)	43 (41.00)	168 (30.70)	304 (35.60)	
Prevalence of Malnutrition					**0.140**
Equal/below the state target	120 (59.70)	65 (61.90)	367 (67.10)	552 (64.70)	
Above the state target	81 (40.30)	40 (38.10)	180 (32.90)	301 (35.30)	
Vaccine Homogeneity					**< 0.001**
Equal/above the state target	65 (32.30)	42 (40.00)	327 (59.80)	434 (50.90)	
Below the state target	136 (67.70)	63 (60.00)	220 (40.20)	419 (49.10)	
Total	**201 (100.00)**	**105 (100.00)**	**547 (100.00)**	**853 (100.00)**	

Source: Own elaboration.

*Chi-square test.

Assessing the Prevalence Ratio (PR), it was found that an MHDI below the state index was more prevalent among intermediate and rural municipalities. In these municipalities, a lower prevalence of FHC coverage below the state level was also identified. Rural municipalities had a prevalence of ICSAP above the state level. In turn, a Premature Mortality Rate above the state rate is less prevalent among rural municipalities; Deaths from Preventable Causes and Prevalence of Malnutrition above the state target are less prevalent among rural municipalities; Vaccination homogeneity below the state target is less prevalent among rural municipalities (*table 3*).

Table 3. Prevalence ratio of social and health indicators according to rural-urban typology, Minas Gerais, Brazil. 2020

Variable	Typology	PRgross (CI95%)
Social Indicators		
MHDI below the state level	Urban	1.00
	Intermediate	1.20 (1.15 – 1.26)
	Rural	1.22 (1.17 – 1.27)
Gini index below the state level	Urban	1.00
	Intermediate	1.00 (0.95 – 1.05)
	Rural	0.99 (0.95 – 1.05)
Health Indicators		
ESF coverage below state coverage	Urban	1.00
	Intermediate	0.83 (0.77 – 0.90)
	Rural	0.77 (0.73 – 0.81)
ICSAP above the state proportion	Urban	1.00
	Intermediate	1.06 (0.98 – 1.15)
	Rural	1.08 (1.02 – 1.14)
Proportion of live births lower than the state target	Urban	1.00
	Intermediate	0.94 (0.87 – 1.02)
	Rural	0.99 (0.94 – 1.04)
Premature Mortality Rate Above State Rate	Urban	1.00
	Intermediate	1.00 (0.99 – 1.02)
	Rural	0.97 (0.95 – 0.98)
Deaths from Preventable Causes above the state target	Urban	1.00
	Intermediate	0.96 (0.89 – 1.05)
	Rural	0.89 (0.85 – 0.95)
Prevalence of Malnutrition above the state target	Urban	1.00
	Intermediate	0.98 (0.91 – 1.07)
	Rural	0.95 (0.90 – 1.00)
Vaccination homogeneity below the state target	Urban	1.00
	Intermediate	0.95 (0.89 – 1.02)
	Rural	0.84 (0.80 – 0.88)

Source: Own elaboration.

PRgross: Gross Prevalence Ratio; CI: Confidence Interval.

Note: It was not possible to adjust multiple models for the indicators evaluated, as some of these have categories with very low n.

Discussion

The state of Minas Gerais has a higher prevalence of municipalities in a rural context, based on the IBGE methodology for classifying municipalities by rural-urban typology. This differs from the assessment that considers the resident population by household situation, which indicates that the state's population lives predominantly in urban areas[16]. In this context, the literature points out that the concentration of households in urban areas is a reflection of the urbanization process, occupation of territories and population dynamics, in which more prosperous cities and regions tend to concentrate more population[21].

On the other hand, despite being the second most populous state in Brazil, behind only the state of São Paulo, Minas Gerais is characterized by having a low demographic density, an extensive area of the territorial unit (586,521.123 Km^2) and the largest number of municipalities among Brazilian states (853), most of which are small municipalities[16]. Notably, 96.5% of Minas Gerais municipalities have up to 100 thousand inhabitants. When evaluating the number of municipalities with a population of up to 20 thousand inhabitants, the percentage reaches 79%[22]. In such municipalities, generally characterized by having low demographic density and extensive rural areas, but quite different from each other, the biggest challenge is to clearly recognize the limits between urban and rural. This finding emphasizes the need to carry out future studies to investigate the social, economic and cultural context of small municipalities[22].

When it comes to economic and social development, Minas Gerais presents great regional disparities. The North and Northeast mesoregions concentrate most of the municipalities with a low Human Development Index (HDI), while the South, Triangle and Alto Paranaíba mesoregions have a prevalence of municipalities with a high HDI[23]. The higher average MHDI among urban municipalities and a higher prevalence of MHDI below the state index among intermediate and rural municipalities in Minas Gerais reflects a reality in which, generally, urban municipalities present greater human development when compared to rural. The literature[24,26] points out that, in Brazil, the pattern of economic and social inequality that prevails in rural territories determines the living and health conditions of people in these territories. Families in the lowest income brackets reside predominantly in rural municipalities, where the highest illiteracy rates are found among people aged 15 or over and the largest number of households lacking basic sanitation[27]. Among Brazilian municipalities with a high percentage of rural population, there are those that have the worst MHDI, indexes influenced mainly by the dimensions of income and education[28].

Regarding FHC Coverage, Minas Gerais presents high coverage rates in all regions, with emphasis on a higher average coverage among rural municipalities and a lower prevalence of coverage below state coverage in intermediate and rural municipalities. The greater insertion of FHC in rural and intermediate municipalities is related to the Ministry of Health's policy of inducing the expansion of FHC in the neediest regions[29]. High FHC coverage is related to less inequality in access to health services for populations that have historically been in a situation of greater vulnerability, low income and lower health plan coverage[11,29].

A study carried out by Andrade et al.[29] showed that, in Minas Gerais, there is a regional disparity in FHC coverage, with less insertion of the strategy in the most socioeconomically developed areas. Regarding home visits by FHC teams, the study showed that poorer regions have higher visitation rates, with emphasis on the North region, where 93.16% of homes were visited during the period evaluated. Furthermore, it was pointed out that households with families with lower purchasing power are more visited, indicating more focused coverage on households with lower incomes[29]. An important dimension

of expanding FHC coverage in Brazil is the prioritization of the most vulnerable families, aiming to expand access, include the most needy and reduce health inequities[11]. Regional disparities are attributed to the diversity of local management processes between municipalities and states. Even with strong induction by the Ministry of Health and states, the organizational processes are varied, which results in large differences in the local implementation of FHC. The differences in FHC coverage between municipalities and regions is a reflection of the health municipalization process[11].

The literature points out that countries whose health systems are guided by the PHC model have better indicators, including lower infant mortality rates, lower early mortality from preventable causes and higher life expectancy[11]. However, in Brazil, there is a great disparity in access to health services when comparing urban and rural areas, so that inequality in access is higher and greater in rural areas[4], establishing a reality in which there is a worse healthcare performance in the rural areas[12].

However, it was identified in the present study that, in addition to having better FHC coverage, rural municipalities presented better results for the indicators of infant, premature and preventable mortality, vaccination homogeneity and prevalence of malnutrition in children under two years of age. Urban municipalities, in turn, presented the best results for ICSAP and the proportion of prenatal consultations.

It is estimated that this fact may be related to greater FHC coverage in rural municipalities, as well as the difficulties imposed on the expansion of FHC in larger municipalities. The literature[30] points out that federal subsidies for financing PHC are more effective in smaller municipalities, which depend more on federal resources than larger municipalities. In fact, small municipalities, with low levels of human development[28] and almost always in rural contexts, generally have little financial autonomy[31] and are highly dependent on transfers of resources from other federative entities (states and the Union) to carry out health actions[32].

Evidence indicates that mortality in general is related to socioeconomic and healthcare factors[33-37]. In Brazil, the decline in mortality trends is related to increased access to health services, but is also attributed to the improvement in general living conditions, reduced inequalities and investments in social income distribution programs[37,38].

Therefore, socioeconomic inequalities and the use of health services have a direct influence on mortality. The worse performance of urban municipalities in relation to the mortality indicators evaluated (IMR, mortality and mortality from preventable causes) may be related to the large number of people living in precarious conditions in urban agglomerations, the lack of or insufficient health services in these locations and the difficulty in accessing the service network for the resident population[33,39,40].

Municipalities with adequate FHC coverage and greater integration of this strategy in the community may have better conditions for monitoring families in PHC[11,29]. Family planning and prenatal monitoring actions have the potential to reduce infant and maternal mortality. Health promotion actions enable changes in lifestyle habits, interfering with the emergence of chronic conditions[3]. In turn, monitoring and adequate management of chronic conditions can reduce premature deaths from preventable causes[11,29].

In Brazil, despite adequate vaccination coverage at national and state levels, vaccination historically still does not reach the entire target population. In municipalities, coverage is heterogeneous, lower in the highest socioeconomic groups, as well as in the lowest. At the individual level, low coverage is related to the level of knowledge, attitudes and practices regarding vaccination actions[41,42]. At the municipal level, low coverage may also be related to the coordination of municipal services in

immunization actions, so that several factors may be involved, such as the supply of immunobiologicals, the population's access to them, the identification of priority areas, the adopted immunization strategy, among others[41,42]. In Brazil, due to the large territorial extension and the variability of vaccination coverage between regions, homogeneity of coverage between vaccines is also assessed. This measure allows us to estimate the proportion of immunobiologicals whose coverage targets were achieved in municipalities or even states over a period of time[41].

Minas Gerais has the complex challenge of achieving desirable and homogeneous vaccination coverage in all of its 853 municipalities and, historically, has achieved the minimum vaccination coverage target for the population of children and the elderly[42]. In the state, the variation in vaccination coverage in municipalities is associated with FHC coverage and population size[42]. Population size and vaccination coverage have an inverse association, with municipalities with larger populations generally having lower vaccination coverage[41].

A study carried out by Souza et al.[43] showed that malnutrition is present in all regions of Brazil, with more emphasis on two areas of hunger (North and Northeast regions) and three areas of malnutrition (South, Southeast and Central-West regions). When comparing nationwide surveys from the 1970s, 1980s and 1990s, a decline in malnutrition in the country was observed, with emphasis on the reduction of approximately 72% in average height in children. The greatest variations were observed in urban areas compared to rural areas, which characterizes malnutrition as a result of socioeconomic inequalities in Brazil[43].

Regarding the prevalence of malnutrition in children under 2 years of age, in Minas Gerais, there was a lower prevalence of rural municipalities in the group of municipalities that presented an indicator above the state target. In other words, considering the target established by SES/MG for the prevalence of malnutrition in children under 2 years of age, which is less than 4.82%, most of the municipalities that had a result above the state target are made up of urban and intermediate. This result may be related to greater FHC[44] coverage, as well as improved living conditions in rural municipalities, reduced inequalities and investments in social income distribution programs[43], but needs to be better investigated in due course.

Higher ICSAP in rural municipalities may be related to the low implementation of FHC in some locations and the inefficient provision of exams and consultations by specialists, which compromises the monitoring of chronic conditions[45]. The long distances to the nearest regional centers, combined with the existence of roads without asphalt paving, geographic barriers and the lack of public transport, are also competing factors that can make it difficult for patients to access exams and specialized consultations[12,46].

The scientific literature points out that differences in ICSAP rates in urban and rural locations can be attributed to differences in access to timely outpatient care and also to decisions made at the time of admission. Patients from rural areas who present clinical conditions that do not justify hospitalization may be admitted as a precaution. After the patient has traveled long distances, and faced with the uncertainty that they will have access to health treatment at another point of care in the network, some doctors adopt the position of admitting these patients with conditions that could be managed and treated in PHC[46].

In turn, larger municipalities with better socioeconomic indicators have a greater health care park, with a greater offer of health, professional and exam services, both in the public and private sectors, in addition to having a higher percentage of people with private health plans. Urban areas, historically, have a greater and better offer of health services[4]. These factors together can influence ICSAP, as people will be better able to manage and treat clinical conditions considered to be a PHC approach in the FHC itself or in other outpatient

services[12,45,46]. This same context can influence prenatal rates, establishing better prenatal indicators in urban municipalities[47].

For the purpose of evaluating these results, improvements in the general living conditions of the population[33], such as economic and social conditions, reduction of inequality and investment in social income distribution programs[37,38,43], can also be considered. Therefore, it is considered that more comprehensive studies are needed to elucidate aspects of access to health services and the population's living conditions not covered in this study.

Recommendations for health managers at the three governmental levels: promoting the consolidation of FHC in unfavorable contexts, such as remote rural locations and urban clusters; implementation of actions aimed at integrating PHC and Health Surveillance; strengthening PHC with a view to offering problem-solving services (trained professionals and offering exams and procedures at UBS); the financing of multi-professional FHC teams with the aim of having greater resolution; articulation of the service network to guarantee access to other levels of care in cases that exceed the management and resolution capacity of PHC, with emphasis on Specialized Outpatient Care and; the establishment of intersectoral actions on issues that go beyond the health sector but that impact the living and health conditions of the population.

The results of this study should be interpreted with caution, given the limitations of the adopted design. The main limitation of ecological studies is the impossibility of relating exposure and outcome at the individual level (ecological fallacy). In turn, cross-sectional studies only describe associations between variables, without the possibility of establishing causality. The limitations inherent to the secondary databases consulted must also be mentioned, which depend on the nutrition, completeness and updating guaranteed by the originating bodies. However, despite such limitations, the topic researched is very relevant to public health and presents useful information to managers and researchers about health care in different municipal contexts, identified within the typologies proposed by IBGE.

Collaborators

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