Research, Society and Development, v. 10, n. 6, e19710615664, 2021
(CC BY 4.0) | ISSN 2525-3409 | DOI: http://dx.doi.org/10.33448/rsd-v10i6.15664

Analysis of adolescent fertility rates and temporal trend in Brazil (2008 to 2017)

Gravidez na adolescência: taxas específicas de fecundidade e tendência temporal, Brasil, (2008 a 2017)

Análisis de las tasas de fecundidad en adolescentes y tendencia temporal en Brasil (2008 a 2017)

Received: 05/01/2021 | Reviewed: 05/09/2021 | Accept: 05/11/2021 | Published: 05/27/2021

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Abstract
This study aims to estimate the adolescent fertility rates in Brazil and regions, providing the time trend, between 2008 and 2017. This is an ecological study of time series. The data were collected from the Live Birth Informational System (SINASC) and the Department of Informatics of the Unified Health System (DATASUS). The time trend of the adolescent fertility rates was calculated using polynomial regression, with a significance level of 5%. For all years studied and all age groups (10 to 19, 10 to 14, and 15 to 19 years old), the North, Northeast, and Midwest regions showed higher rates than Brazil, whereas the South and Southeast regions had lower rates than national. The Northern region had the highest fertility rates, varying from 103.2 per 1,000 adolescent women in 2008 to 80.9 per 1,000 adolescent women in 2017, for the aged 15-19 years. Brazil and other regions showed a significant decreasing trend in fertility rates for all age groups. However, the rates remain high, particularly in the North and the Northeast regions. We emphasize the necessity of specific actions towards adolescents, considering the regional differences and the equity in health care.
Keywords: Teenage pregnancy; Maternal and child health; Health surveillance.

Resumo
Esse estudo teve como objetivos estimar as taxas específicas de fecundidade de adolescentes, bem como a tendência temporal, para o Brasil e regiões, entre 2008 e 2017. Estudo ecológico de séries temporais. Os dados foram coletados do Sistema de Informações sobre Nascidos Vivos (SINASC). A tendência das taxas foi calculada por regressão polinomial, com nível de significância de 5%. As regiões Norte, Nordeste e Centro-Oeste apresentaram taxas maiores do que o Brasil e as regiões Sudeste e Sul apresentaram taxas menores, em todos os anos pesquisados, para as três faixas de idade (10 a 19, 10 a 14 e 15 a 19 anos). As maiores taxas ocorreram na região Norte, sendo 103,2 por 1.000 mulheres adolescentes em 2008 e 80,9 por 1.000 mulheres adolescentes em 2017, para a faixa etária de 15 a 19 anos. O Brasil e as regiões apresentaram tendência significativa decrescente de fecundidade, em todas as faixas etárias. Contudo, as taxas permaneceram altas, principalmente nas regiões Norte e Nordeste. Enfatiza-se a necessidade de ações específicas direcionadas para adolescentes, que considerem as diferenças regionais e a equidade da atenção em saúde.
Palavras-chave: Gravidez na adolescência; Saúde materno-infantil; Vigilância.

Resumen
Esto estudio tuvo como objetivo estimar las tasas específicas de fecundidad en adolescentes, así como la tendencia temporal, para Brasil y regiones, entre 2008 y 2017. Estudio ecológico de series temporales. Los datos fueron recogidos en lo Sistema de Información sobre Nacidos Vivos (SINASC). La tendencia de las tasas se calculó por regresión polinomial, con nivel de significación de 5%. Las regiones Norte, Nordeste y Centro-oeste presentaron tasas mayores que el Brasil mientras las regiones Sur y Sudeste presentaran tasas menores, en todos los años estudiados, para las tres franjas etarias (10 a 19, 10 a 14 y 15 a 19 años). Las mayores tasas ocurrieron en la región Norte, de

103,2/1000 en 2008 y 80,9/1000 en 2017, para la franja etaria de 15 a 19 años. Brasil y sus regiones presentaron tendencia significativa decreciente de fecundidad en adolescentes, en todas las franjas etarias. Pero, las tasas permanecerán altas, principalmente en las regiones Norte y Nordeste. Se enfatiza la necesidad de acciones específicas dirigidas para adolescentes, que consideren las diferencias regionales y la equidad en la atención a la salud.
Palabras clave: Embarazo en adolescencia; Salud materno-infantil; Vigilância.

1. Introduction

Adolescence is the transitional period between childhood and adulthood, which, according to The World Health Organization (WHO), includes ages 10 to 19. This phase is characterized by complex transformations in the biological, psychological, and social areas (Brasil, 2006), and pregnancy during this period may entail risks to the newborn and the new mother (Leftwich; Alves, 2017). Adolescent pregnancy is related to a higher occurrence of prematurity (Aragão; Silva; Aragão et al., 2004; Goldenberg; Figueiredo; Silva, 2005) and low birth weight, besides the late beginning of prenatal health care (Goldenberg; Figueiredo; Silva, 2005). Poor socioeconomic and geographic conditions, and family structure and difficulty to access assistance services, maximize the complications related to pregnancy in this age group (Ramos; Cuman, 2009). Therefore, adolescent pregnancy comes out as a significant public health concern.

In Brazil, one in every five women had her first child during the teenage years, specifically before 20 years old (Cesar et al., 2011). The world teenage pregnancy rate is estimated in 46 per thousand adolescents aged 15-19 years, from 2010 to 2015, whereas the rate of Latin America and the Caribbean is estimated at 66.5, only outnumbered by Sub-Saharan Africa (Organización Panamericana de la Salud, 2016).

The analysis of adolescent fertility rates is of great relevance, considering the risks to maternal and child health. Besides, literature on the issue is scarce, so the results might be an important source of information in the development of actions and public policies directed to maternal and child health. This study aimed to estimate the fertility rates of adolescents, as well as the temporal trend for Brazil and regions, from 2008 to 2017.

2. Methodology

This is an ecological study of time series. In ecological studies, the observation unit is a set of individuals, and geographical areas are used as units of analysis (Pereira, 2002). The characteristics identified relate to a large population, reflecting the social phenomenon of teenage pregnancy in its collective rather than individual occurrence (Martinez et al., 2011).

The data of live births from mothers aged 10-19 years. Data collection occurred in the Live Birth Informational System (SINASC), available at the electronic address of the Informatics Department of the Unified Health System (DATASUS). The data of the resident female population aged 10- 19 years were also collected in DATASUS.

The adolescent fertility rates were calculated through the math division between the live births in the year from resident mothers aged 10-19 years, by the total resident female population in the same year and area, between 10 and 19 years old, multiplied by 1,000 (Brasil, 2021). The values are shown in terms of live births per 1,000 adolescent women (AW). The calculations were made for Brazil and regions.

Because there are considerable differences between a girl who is 12 or 13 years old and a young woman of 19 years old, authors sometimes differentiate adolescents aged 10-14 years and 15-19 years. In general, countries use fertility rates of AW aged 15-19 years for comparisons. Although, sometimes, data on pregnancies and live births of younger AW aged 10-14 years are also available (World Health Organization, 2004). This study opted for also calculating the fertility rates of this younger age group. Therefore, the calculations were made for the age groups of 10 to 19, 10 to 14, and 15 to 19 years old.

The temporal trend of the fertility rates was calculated by the polynomial regression method, considering rates as a dependent variable (Y) and the years of study as an independent variable (X). Construction of dispersion diagrams between

rates and years of study enabled the identification of the function that expressed the relationship between them, to choose the polynomial order for analysis. From this association we used a polynomial regression model estimation (Latorre; Cardoso, 2001). The coefficient of determination (r^2) was a measure of precision. Initially, the simple linear regression model was tested ($Y = \beta_0 + \beta_1 X$), later, the higher order second degree ($Y = \beta_0 + \beta_1 X + \beta_2 X^2$), and the third degree ($Y = \beta_0 + \beta_1 X + \beta_2 X^2 + \beta_3 X^3$) models. The best model was the one with the highest statistical significance in addition to residues without bias. The principle of parsimony was used for statistically similar models (Latorre; Cardoso, 2001). There was smoothing in the time series variations through a moving mean centered in three successive means.

The data were processed on electronic spreadsheets using Microsoft Office Excel® 2010 for Windows®. The software used for statistical analysis was the Statistical Package for Social Science (IBM SPSS *Statistics*), version 15.0. The level of statistical significance was set at $p < 0.05$. The Research Ethics Committee (CEP) approved this project under opinion number 2.991.249, CAAE 01605018.9.0000.0105.

3. Results and Discussion

The adolescent fertility rates were calculated from the 5,500,134 live births of adolescent mothers, between 2008 and 2017. Table 1 shows the adolescent fertility rates of live births of adolescent mothers, for the three age groups, for Brazil and regions, from 2008 to 2017.

Table 1. Adolescent fertility rates of live births to adolescent mothers (per 1,000 adolescent women), Brazil and regions, 2008 to 2017.

	Ano									
Age 10 to 19 years	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**
Brazil	35.4	34,0	32.7	33.2	33.2	33.2	33.5	32.8	30.2	29.2
North	53.1	50.4	48.2	49.2	48.1	48.4	49,0	47.5	44,0	42.7
Northeast	40.3	38.4	36.5	37.2	36.5	36,0	36,0	35.7	33.4	32.7
Midwest	36.5	34.9	33.9	34.1	34.7	35,0	35.8	34.2	31.4	30,0
Southeast	29.1	28.1	27.2	27.6	28,0	28.2	28.5	29.1	28.1	27.2
South	29.4	28.7	28.2	28.2	28.7	29.2	29.2	28.4	25.9	24.3
Age 10 to 14 years										
Brazil	3.4	3.3	3.2	3.3	3.3	3.3	3.4	3.2	3,0	2.8
North	6,0	5.8	5.7	6,0	6,0	6,0	5.9	5.7	5.5	5,0
Northeast	4.2	4.1	4,0	4.2	4.1	4,0	3.9	3.9	3.6	3.5
Midwest	3.7	3.5	3.4	3.4	3.5	3.5	3.7	3.3	3.1	2.8
Southeast	2.4	2.3	2.1	2.2	2.3	2.3	2.4	2.3	2,0	1.8
South	2.6	2.6	2.5	2.4	2.5	2.5	2.7	2.3	2.1	1.8
Age 15 to 19 years										
Brazil	67.3	64.6	62.2	63.1	63,0	63.1	63.4	61.8	56.5	54.4
North	103.2	97.5	92.6	94.2	91.7	92.3	93.4	90.7	83.4	80.9
Northeast	76.3	73,0	69.7	71.3	70.3	69.5	69.5	68.6	63.6	61.8
Midwest	68.8	65.4	63.2	63.5	64.5	64.9	66.4	64,0	58.4	55.5
Southeast	55.4	53.6	52,0	52.7	53.4	53.5	53.7	51.9	46.8	45,0
South	55.8	54.3	52.9	52.9	53.6	54.3	54.2	53,0	48,0	45.2

Source: Prepared by the authors based on data from SINASC, DATASUS (2020).

The North, Northeast, and Midwest regions had higher rates than Brazil for all years studied and all age groups, except the Midwest region in 2017, for the age group of 10 to 14. South and Southeast regions showed lower rates than national for all years and age groups studied. Between regions, the highest fertility rates per 1,000 AW occurred in the North region, and the lowest rates, in the Southeast and South regions, for all age groups (Table 1).

The highest fertility rate occurred in the North region in 2008 (103.2 per 1,000 AW) for the age group of 15 to 19 years and the lowest rates in the Southeast and South regions (1.8 per 1,000 AW) for the age group of 10 to 14 years (Table 1).

Adolescent fertility suffers influence by social, biological, behavioral, and structural factors. Besides, the variables that increase the risk of teenage pregnancy include higher income inequality, lower menarche age, lower age of first sexual relationship, and first marriage (Santelli et al., 2017).

A study analyzed the relationship between the spatial concentration of production and social inequality in Brazil. In 2014, the South and Southeast regions concentrated over 71,35% of the Gross Domestic Product (GDP), with 56,29% of the population of the country, whereas the Northeast participated with 13,93% in the GDP, with 27,69% of the population. Regarding the income sectoral analysis and the gross revenue of the companies, a gap between the North/Northeast regions and the South/Southeast regions was observed, reinforcing the maintenance of the social inequalities between the two groups of regions. In terms of investment in public health, in poorer states, the absolute values are much smaller than in wealthier states. Besides, the prices in health procedures are standardized in the whole country and the coverage of private health insurance plans is smaller in poorer states, this reality is, therefore, visibly unfavorable to the states in the North and Northeast regions (Pochmann; Silva, 2021).

Adolescent fertility rates also differed around the world. The fertility rate of women aged 15-19 years in the European Union in 2008 was 12.5 per 1,000 AW, and, in 2017, 9.1 per 1,000 AW (United Nations, 2019). European rates, therefore, are smaller than Brazilian rates.

In the United States, the fertility rates were also much lower than in Brazil. For women aged 10-14 years, the rate was 0.4 per 1,000 AW in 2010 and 0.2 per 1,000 in 2017 and, for the age group aged 15-19 years, the rate was 34.2 per 1,000 in 2010 and 18.8 per 1,000 AW in 2017 (Martin et al., 2018). These rates confirm the necessity of discussing the public policies regarding the prevention of adolescent pregnancy in Brazil.

In Latin America, the fertility rates of women aged 15-19 years showed variable values. The fertility rates for this age group in Mexico (69.4 per 1,000 AW in 2008 and 60.4 per 1,000 AW in 2017) and Peru (69.7 per 1,000 AW in 2008 and 56.9 per 1,000 AW in 2017) were higher than in Brazil. Whereas in Chile, the rates for the same population were estimated at 54.8 per 1,000 AW in 2008 and 41.1 per 1,000 AW in 2017, smaller than in Brazil (United Nations, 2019).

Latin America and the Caribbean are the region with the second highest fertility rate among adolescent women aged 15-19 years, second only to Sub-Saharan Africa (Organización Panamericana de la Salud, 2016). Sub-Saharan Africa shows the highest fertility rates in teenagers aged 15-19 years. The rate were estimated in 118.3 per 1,000 AW in 2008 and in 102.8 per 1,000 AW in 2017, revealing a reality worse than in Brazil (United Nations, 2019).

Table 2 shows the temporal trends for adolescent fertility rates, from 2008 to 2017.

Table 2. Temporal trends for adolescent fertility rates of live births to adolescent mothers (per 1,000 adolescent women), Brazil and regions, 2008 to 2017.

Age 10 to 19 years	**Model***	**r^2**	***p***	**Trend**
Brazil	Cubic	0.97	<0.001	decreasing
North	Cubic	0.98	<0.001	decreasing
Northeast	Cubic	0.99	<0.01	decreasing
Midwest	Cubic	0.94	<0.001	decreasing
Southeast	Cubic	0.95	<0.001	decreasing
South	Cubic	0.94	<0.001	decreasing
Age 10 to 14 years				
Brazil	Cubic	0.93	0.001	decreasing
North	Cubic	0.94	<0.001	decreasing
Northeast	Cubic	0.91	0.001	decreasing
Midwest	Cubic	0.96	<0.001	decreasing
Southeast	Cubic	0.97	<0.001	decreasing
South	Cubic	0.97	<0.001	decreasing
Age 15 to 19 years				
Brazil	Cubic	0.93	0.001	decreasing
North	Cubic	0.93	0.001	decreasing
Northeast	Cubic	0.92	0.001	decreasing
Midwest	Cubic	0.94	0.001	decreasing
Southeast	Cubic	0.94	<0.001	decreasing
South	Cubic	0.94	0.001	decreasing

Source: Prepared by the authors based on data from SINASC, DATASUS (2020).
* Cubic polynomial regression models ($Y = \beta_0 + \beta_1 X + \beta_2 X^2 + \beta_3 X^3$)

Brazil and all five regions had a significant decreasing trend of fertility rates between 2008 and 2017, for all age groups. The values of the coefficient of determination, which determine how much of the series can be explained by the respective model, were high, from 0.91 to 0.99 (Table 2).

A previous study carried out in Brazil and regions showed that adolescent fertility rates (aged 10-14 years) remained stable in all regions, except Midwest and South, which presented a significant decrease (Borges et al., 2016). The temporal trend of adolescent fertility rates seems to be changing in recent years, considering the decreasing trends seen in this study for all age groups.

Park and collaborators (2013) evaluated the variations and trends of the adolescent fertility rates (aged 15-19 years), among countries and regions in the European Union, from 2001 to 2010, in the context of legislation and services of sexual and reproductive health of young people. The authors described that adolescent pregnancy rates decreased over time, although progress had been unequal among regions and countries. The Eastern Europe showed the highest average rate (41.7 per 1,000) compared to the Northern (30.7 per 1,000), Western (18.2 per 1,000) and the Southern Europe (17.6 per 1,000). Those rates constitute much lower values than this studied showed for Brazil and regions.

Data from 142 countries and 7 regions, between 1990 and 2012, were used to explore the association of trends in national socioeconomic status indicators with trends in adolescent birth rates. The most drastic decline happened in South Asia, Europe/Central Asia, and the Middle East/North Africa, regions with lower income inequality, whereas the smallest declines for Latin America and the Caribbean, and Sub-Saharan Africa. The decline in trends in adolescent birth rates closely followed rising socioeconomic status and was greater where income inequalities were lower in 1990 (Santelli et al., 2017).

Marginalization and poverty were significantly associated with adolescent pregnancy and fertility rate in a study conducted with adolescents aged 15-19 years in Mexico, in 2015 (Gómez; González, 2018).

In Brazil, demographic data shows the relationship between adolescent pregnancy and situations of vulnerability present in the lives of some young men and women who experience parenthood. Among the most important determinants of teenage pregnancy are the early onset of sexual intercourse and menarche; sexual violence; early marriages; the low rate of use of modern contraceptives; low access to quality education and comprehensive sexuality education; school dropout and delay; and unequal gender relations (Fundo de População das Nações Unidas, 2021).

Martinez and cols. (2011) investigated the spatial association between teenage pregnancy proportions and socioeconomic characteristics of municipalities in São Paulo State, Brazil. Early pregnancy was more frequent in municipalities with lower *per capita* gross domestic product, higher poverty rate, smaller population, lower human development index, and a higher percentage of individuals with greater social vulnerability.

Given this context in Brazil and other countries, we emphasize the importance of reducing socioeconomic inequalities and joining efforts from the community, health services, and public administrators towards implementing public policies offering preventive health actions, therefore avoiding undesired teenage pregnancies. Also offer adequate care to teenage mothers, thereby promoting the health and the wellbeing of those adolescents and their children.

This study had limitations, such as the source of secondary information systems (SINASC and DATASUS), that may have inconsistencies. Nevertheless, SINASC has high coverage, completeness, and reliability, which can reduce these limitations (Bonilha et al., 2011). Only the total number of live births to adolescent mothers was used, not the total number of teenage pregnancies. In this way, it was not possible to quantify the number of abortions and stillbirths. Despite these limitations, this study contributed to a greater understanding of the adolescent fertility rates and the time trend, in Brazil and regions.

4. Conclusion

Brazil and all five regions showed a declining trend in adolescent fertility, nonetheless, the rates remained high, especially in the North and Northeast regions. Those two regions had higher rates than Brazil, whereas the South and Southeast regions had lower rates than national, for all age groups and all years studied. It emphasizes the necessity of specific actions towards adolescents, taking into consideration the regional differences and the equity in health care.

More studies on the theme should be conducted, especially researching teenage pregnancy and certain factors such as age of first intercourse and menarche; early marriages; contraceptive use; access to sexuality education; educational and professional perspectives; and family and cultural aspects.

Acknowledgments

To *Conselho Nacional de Desenvolvimento Científico e Tecnológico* (CNPq) and *Fundação Araucária de Apoio ao Desenvolvimento Científico e Tecnológico*, for the financial support.

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