SOCIAL INEQUALITY, HUMAN DEVELOPMENT AND FERTILITY PATTERN IN BRAZIL

Gabrielle Braga Carreira[1], Viviane Gomes Parreira Dutra[2], José Henrique Costa Monteiro da Silva[3], Raphael Mendonça Guimarães[4]

ABSTRACT

Objective: To analyze the fertility pattern in Brazil and its relation with human development in the Brazilian federation units in 2000 and 2010.

Methods: This is an ecological study whose unit of analysis was the Brazilian Federative Units in the period of 2000 and 2010 (Gini, Theil and Income Ratio) and indicators of fertility (fertility rate and mean age of fertility).

Results: Brazil has been experiencing a rapid fertility transition. The pattern of fertility curves changed in all FH between 2000 and 2010, with a reduction in cusp size and postponement of fecundity. This change was more evident among the UF with better development and lower inequality. The correlation between social and fertility indicators lost strength in the period, corroborating the transition hypothesis.

Conclusions: There is a direct relationship between the indicators of fecundity and inequality, and inverse with human development. Changes in the age structure of the population, as well as inequality indicators, should be considered for better planning of public policies in public health.

Key-words: Fertility; Demography; Human Development Index; Fertility postponement; Public policy.

INTRODUCTION

During the twentieth century, the global population underwent unprecedented increases in economic and social development, which coincided with substantial declines in human fertility and population growth rates. The history of the demographic and cultural behavior of certain populations has taken on a more diversified picture, through local and regional variations, gaining recognition of new patterns in an important way[1].

There is unequivocally a "fertility revolution" process, which is embedded in the processes inherent to the modernization of society in general: economic and productive modernization (new productive models, transportation, etc.), demographic modernization (new fertility regimes, mortality and migration, influenced by advances in public health) and individual modernization (greater openness to individual freedoms and the pursuit of individual and child self-fulfillment)[2]. These phenomena have led to a reduction in fertility from six to two children per woman, representing a gain in individual female liberties in terms of having more time for their own use[3]. That is, the

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modernization of reproductive behavior is based on the autonomy of the couple to decide their own reproductive behavior, overcoming the biological and social determinants (customs) that previously were placed as determinants of the size of the family[2,4].

The negative association of fertility with economic and social development, often assessed through the Human Development Index (HDI), has become one of the most solidly established theories, and has presented some empirical regularity in the data, thereby gaining credibility in the social sciences[5]. As a result of this close connection between development and a decline in fertility, more than half of the global population lives in regions with below-replacement fertility rates (fewer than 2.1 children per woman of childbearing age)[6].

Particularly, in several countries including Brazil, the factors that are negatively correlated with low fertility during the fertility transition period are mainly income and educational level. Although it is observed that the fertility rate becomes more and more homogeneous among the different socioeconomic levels of social groups, between the extremes of these groups, rates still present a significant difference[7]. In this case, it is evident that the formulation of policies, mainly thinking about their effectiveness, depends on more careful analysis of the scenarios which weigh the inequality of income distribution and access to schooling and health services. Thus, it is necessary to evaluate the new scenario of the demographic transition, with possible postponement of age at first gestation. Therefore, the objective of the present study is to analyze the fertility pattern in Brazil and its relationship with human development in the federative units in Brazil between 2000 and 2010.

METHODOLOGY

Study design

This is an ecological study whose unit of analysis was the Brazilian federative units in the period from 2000 to 2010. Fertility was evaluated considering the following indicators:

Social indicators

a) Gini index

This measures the degree of inequality in the distribution of individuals according to per capita household income. Its amplitude goes from zero, when there is no inequality, to 1, when the inequality is at a maximum;

b) Theil's L index

This measures inequality in the distribution of individuals according to per capita household income, excluding those with zero per capita household income. It is calculated through the logarithm of the ratio between the arithmetic and geometric means of household income per capita of individuals, ranging from zero – when there is no income inequality, and infinite – when inequality tends to the maximum;

c) Ratio of 10% richest/40% poorest

This evaluates the degree of inequality in the distribution of individuals according to per capita household income. It compares the average per capita income of individuals belonging to the richest quintile and the two poorest quintiles;

d) HDI

This is a multidimensional index that evaluates the development conditions of the sites. It is calculated by the geometric mean of the sub-indices of the dimensions Income, Education and Longevity, with equal weights.

i) HDI Income: obtained from the indicator "income per capita"

ii) HDI Longevity: obtained from the indicator of life expectancy at birth

iii) HDI Education: a synthetic sub-index, obtained by means of the geometric mean of the frequency of children and young people in school, with a weighting of two-thirds, and of education of the adult population, with a weighting of one-third.

Fertility indicators

Correction in the volume of births

For methodological and operational reasons, longitudinal analyses with cohort data are uncommon. This is because all the necessary data are not always available. Additionally, there may be a problem with the quality of the data available. To overcome these difficulties, indirect methods are used to calculate some statistics. It is important to note that fertility time effects are defined as period-level changes, and do not necessarily reflect changes in the level of total fertility of the cohorts. Changes in the ages at which women give birth to their children show that fertility measured at a given time (period) may not be a good representation of the final fertility of these women. In this sense, the Gompertz synthetic relational method was used, considering the period of the study, thus better simulating the behavior of the cohorts.

From the volume of births duly corrected, the following indicators of fertility were elaborated:

a) Specific fertility rate (TEF)

This is the ratio between the number of live births to mothers in a certain age group and the number of women in the same age group.

It is a more refined indicator, since it specifies the fertility in the age groups. Usually, it is calculated with quinquennial bands, between 15 and 49 years.

b) Total fertility rate

This is the average number of children a woman would have at the end of the reproductive period (current fertility). The total fertility rate (TFT) depends on the TEF set, since it is calculated from its summation, considering the age range:

Since TFT is not influenced by the age distribution of women in the reference population, TFTs from different populations can be used to compare fertility levels.

c) Mean age of fertility

The average age of fertility is the ratio between the sum of the specific mean and fertility rates in each age group and the sum of the specific fertility rates:
This calculation, because it is based on the specific fertility rates, allows neutralization of the distortions provoked by alterations of the age structure of the female population, facilitating comparison between different units of the federation.

Data analysis

Initially, fertility indicators were described for the years 2000 and 2010, in each Brazilian federative unit, through averages and deviations. After that, the fertility curves were elaborated for the two years, by federative unit.
The relationship between TFT and mean fertility age (MFI) was explored in an attempt to observe a change in the period analyzed. Finally, tests were performed to verify simple association between the variables of fertility and social indicators, using the Spearman correlation coefficient. A correlation whose p-value was less than 0.05 was considered statistically significant.

RESULTS

Brazil has been experiencing a rapid transition in fertility. This difference is evident when we observe the variability of the synthetic indicators of fertility (TFT and MFI) in 2000 and 2010 (Table 1). In addition to a reduction in TFT and an increase in MFI, there was a reduction in the variability of both, pointing to a convergence around the mean. It is important to note that the variation of the indicators shows, in general, an improvement in social indicators, as well as ratifying the transition in fertility mentioned above (Figure 1).

This theory is consistent with the general analysis of federative unit (UF) fertility curves (Figure 2). In general, there is a behavior of postponement of fertility, regardless of the location analyzed. However, there is difference in the level, either in the difference in the 2000 curve or in the speed with which the phenomenon occurs, which results in the differences observed between the UF, when comparing the curves for 2000 and 2010. With the changes, besides the difference level, there is evidence of a change in the shape of the fertility curve. It is noticed that the higher TEF are concentrated in the younger age bands (15 to 19 and 20 to 24 years). There is also a continuous reduction in the TEF of adolescents as of 2000, as well as an increase in the relative participation of women in the age groups 25–29 and 30–34. Finally, in some areas, the occurrence of a less obvious cusp is observed. This pattern is more noticeable among more developed units, such as those of the South and the Federal District.

Thus, there are changes in both the level and structure of the fertility curves (time and quantum effect). Our results tend to support the growing hypothesis of age heterogeneity at first birth in several countries and regions. In particular, South–South axis states show the highest level of dispersion in the onset of fertility postponement, resulting in a lower TFT.

The results for UF corroborate the hypothesis that fertility decline seems to be more influenced by the evident reduction in births from the second (20 to 24 years) and third orders (25 to 29 years), and a slight increase in the larger orders. Thus, although there was a reduction in fertility rates, this change is less significant in the MFI (Figure 3).

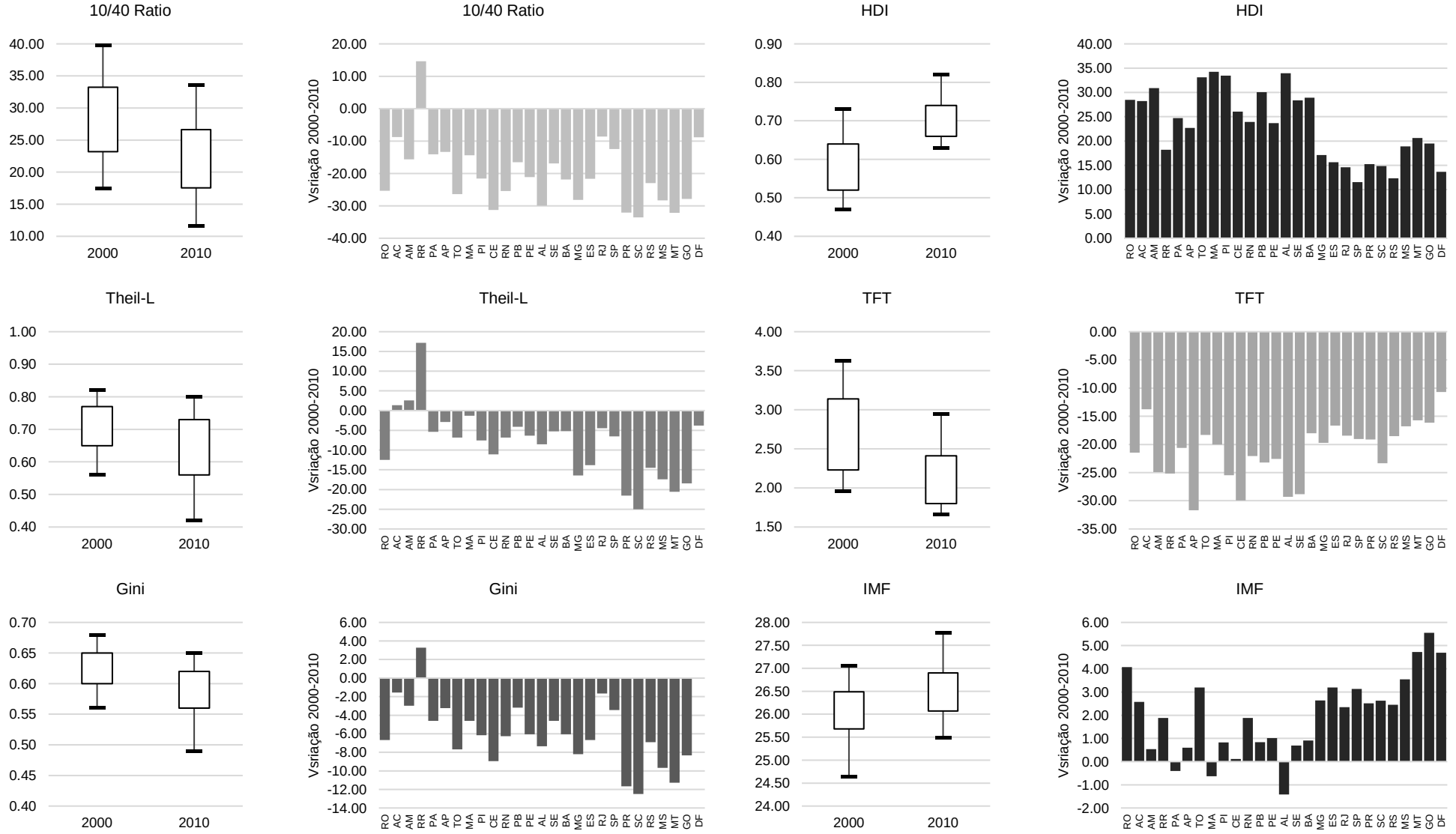
When the observed fertility index is expressed, the TFT for the values of the main social indicators evaluated (Gini index, Theil's L index, income ratio and HDI), it is observed that there is a difference between the years 2000 and 2010. The analysis suggests that in 2000, the relationship between these indicators was more evident, and that it had weakened by 2010. In fact, when the correlation coefficients are observed (Table 2), most correlations which were strong and significant in 2000 became weaker and no longer significant in 2010. The direct relationship between the indicators of inequality and TFT show an inverse correlation between human development and TFT. However, when this correlation was shown to be significant, it was only for TFT, and not for MFI.

Table 1: Social and Fertility Indicators according to the federation unit. Brazil, 2000 and 2010.

Federal Unit	Social Indicators								Reproductive Indicators			
	10/40 Ratio		Theil - L Index 2000		Gini Index 2000		HDI		TFT		IMF	
	2000	2010	2000	2010	2000	2010	2000	2010	2000	2010	2000	2010
Rondônia	23.92	17.86	0.64	0.56	0.60	0.56	0.537	0.69	2.75	2.16	24.64	25.64
Acre	32.17	29.35	0.72	0.73	0.64	0.63	0.517	0.663	3.42	2.95	25.74	26.40
Amazonas	39.77	33.55	0.78	0.8	0.67	0.65	0.515	0.674	3.45	2.59	26.02	26.16
Roraima	26.95	30.89	0.64	0.75	0.61	0.63	0.598	0.707	3.22	2.41	25.68	26.16
Pará	30.56	26.25	0.74	0.70	0.65	0.62	0.518	0.646	3.15	2.50	25.60	25.49
Amapá	27.79	24.07	0.70	0.68	0.62	0.60	0.577	0.708	3.63	2.48	26.09	26.24
Tocantins	31.68	23.33	0.73	0.68	0.65	0.60	0.525	0.699	2.95	2.41	24.91	25.70
Maranhão	33.43	28.61	0.75	0.74	0.65	0.62	0.476	0.639	3.20	2.56	25.79	25.62
Piauí	33.69	26.43	0.79	0.73	0.65	0.61	0.484	0.646	2.67	1.99	25.77	25.98
Ceará	36.33	24.97	0.81	0.72	0.67	0.61	0.541	0.682	2.84	1.99	27.03	27.06
Rio Grande do Norte	30.83	22.99	0.73	0.68	0.64	0.60	0.552	0.684	2.54	1.98	26.22	26.71
Paraíba	28.95	24.17	0.73	0.70	0.63	0.61	0.506	0.658	2.54	1.95	26.39	26.61
Pernambuco	33.76	26.63	0.79	0.74	0.66	0.62	0.544	0.673	2.48	1.92	26.01	26.27
Alagoas	38.76	27.17	0.82	0.75	0.68	0.63	0.471	0.631	3.14	2.22	26.44	26.07
Sergipe	30.93	25.71	0.76	0.72	0.65	0.62	0.518	0.665	2.74	1.95	26.70	26.88
Bahia	33.24	25.98	0.77	0.73	0.66	0.62	0.512	0.66	2.50	2.05	26.42	26.66
Minas Gerais	24.03	17.26	0.67	0.56	0.61	0.56	0.624	0.731	2.23	1.79	26.63	27.33
Espírito Santo	22.65	17.74	0.65	0.56	0.60	0.56	0.640	0.740	2.16	1.80	25.94	26.76
Rio de Janeiro	23.18	21.19	0.67	0.64	0.60	0.59	0.664	0.761	2.06	1.68	26.20	26.81
São Paulo	20.10	17.60	0.61	0.57	0.58	0.56	0.702	0.783	2.05	1.66	26.49	27.32
Paraná	22.43	15.23	0.65	0.51	0.60	0.53	0.650	0.749	2.30	1.86	26.24	26.90
Santa Catarina	17.51	11.63	0.56	0.42	0.56	0.49	0.674	0.774	2.23	1.71	26.61	27.31
Rio Grande do Sul	20.30	15.64	0.62	0.53	0.58	0.54	0.664	0.746	2.16	1.76	27.05	27.71
Mato Grosso do Sul	24.48	17.55	0.69	0.57	0.62	0.56	0.613	0.729	2.50	2.08	25.21	26.11
Mato Grosso	24.75	16.79	0.68	0.54	0.62	0.55	0.601	0.725	2.42	2.04	24.67	25.84
Goiás	22.55	16.27	0.65	0.53	0.6	0.55	0.615	0.735	2.23	1.87	24.81	26.18
Distrito Federal	30.96	28.23	0.79	0.76	0.63	0.63	0.725	0.824	1.96	1.75	26.54	27.78
Total	30.31	22.78	0.76	0.68	0.64	0.6	0.612	0.727	2.37	1.89	26.25	26.75

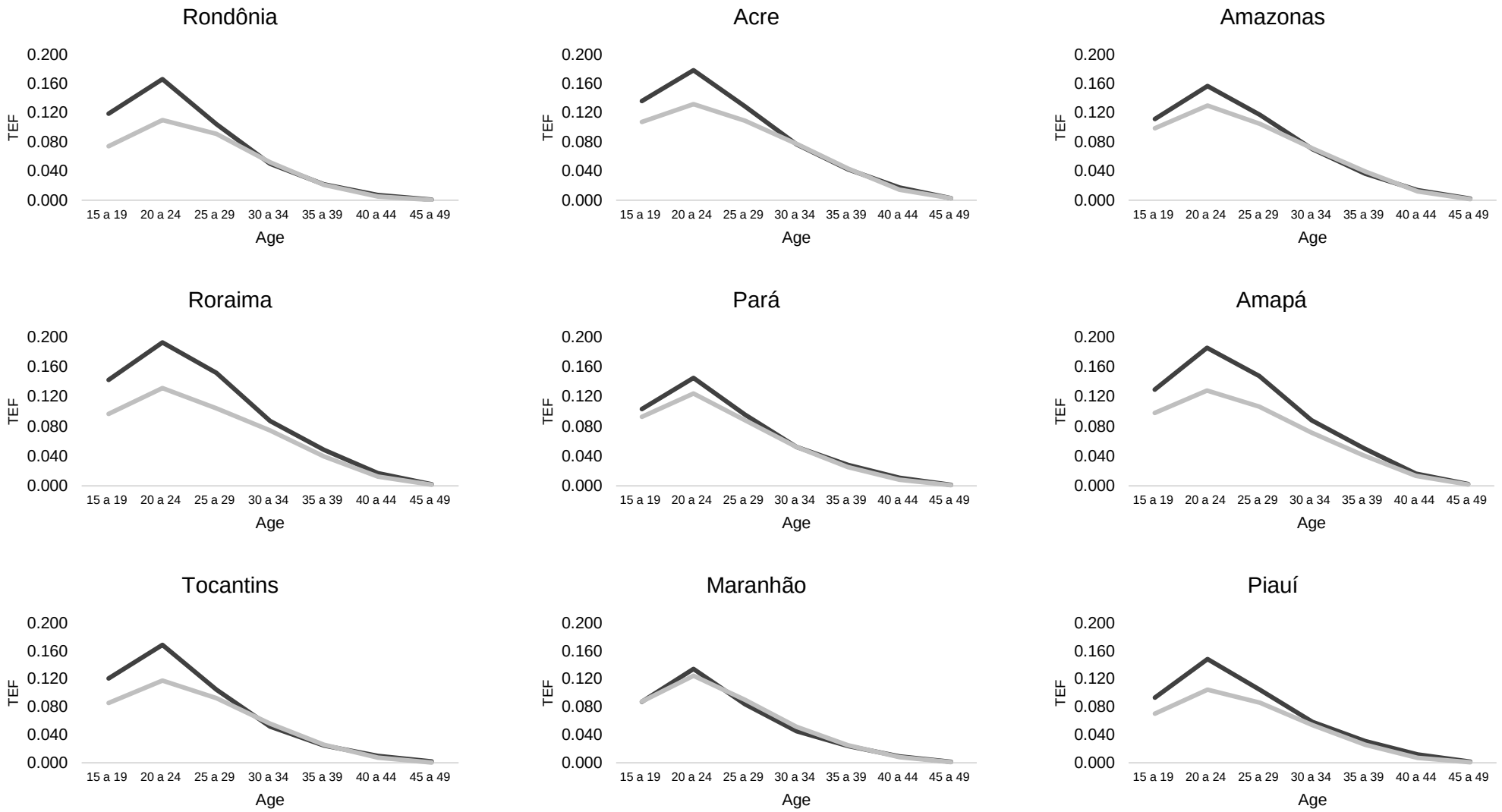
Legend: 10/40 Ratio – Average per capita income ratio of the richest 10% and the poorest 40%; HDI – Human Development Index; TFT – Total Fertility Rate; IMF – Mean Age at Fertility.
Source: DATASUS, 2018; IBGE 2018.

Figure 1: Distribution of social and fertility indicators and time variation according to the federation Unit. Brazil, 2000 and 2010.



Fonte: DATASUS, 2018.

Figure 2: Fertility pattern according to federation Unit. Brazil, 2000 and 2010.



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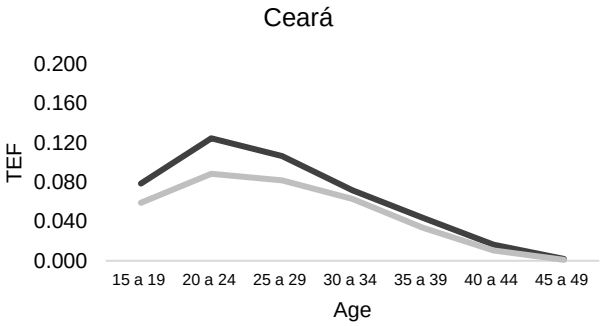
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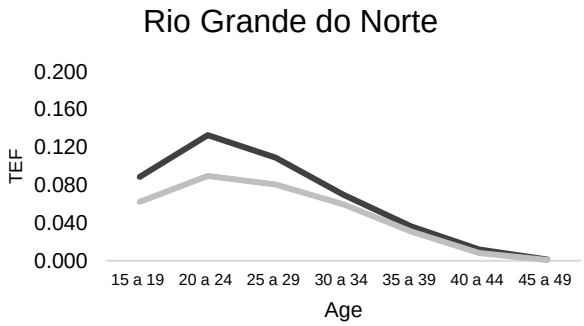
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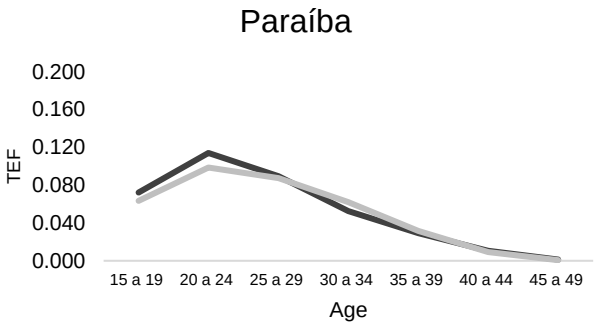
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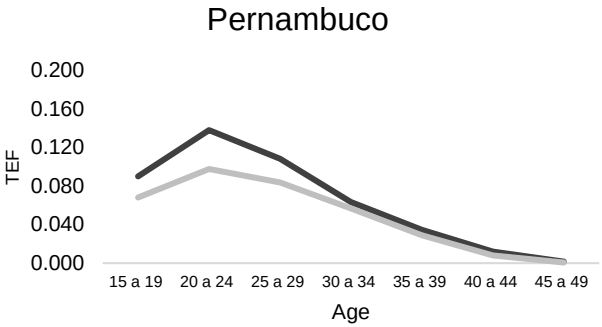
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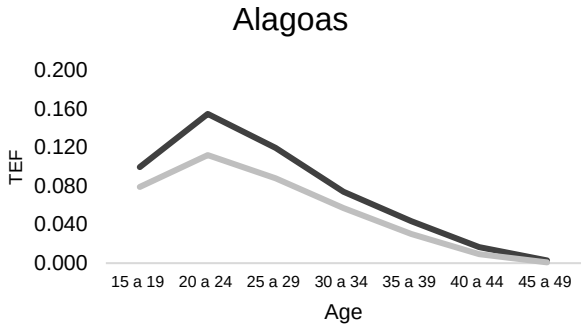
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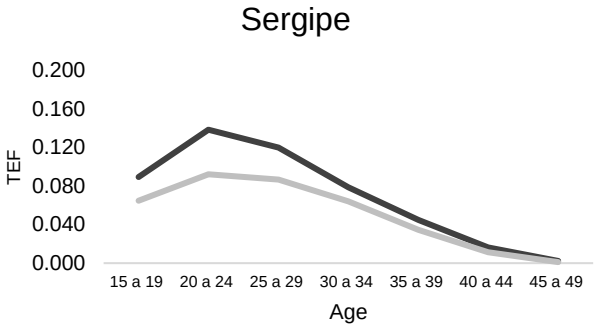
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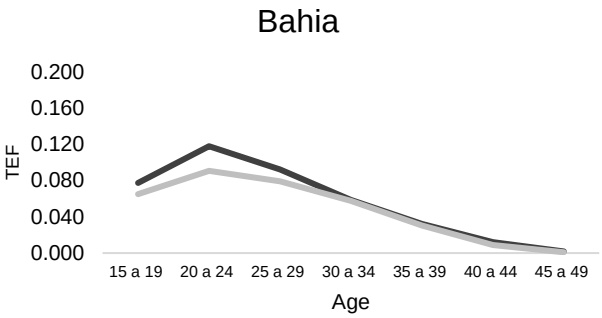
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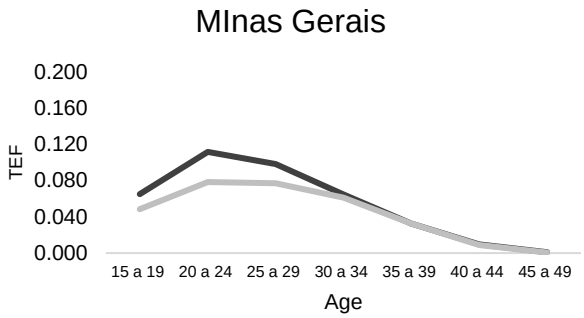
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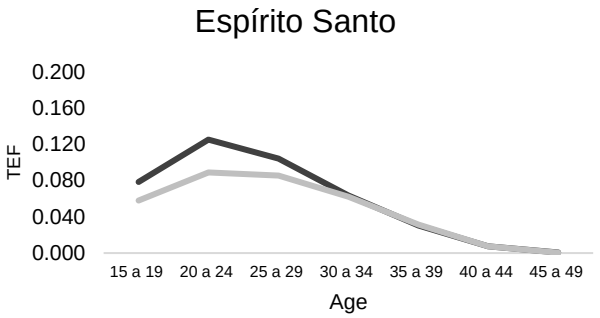
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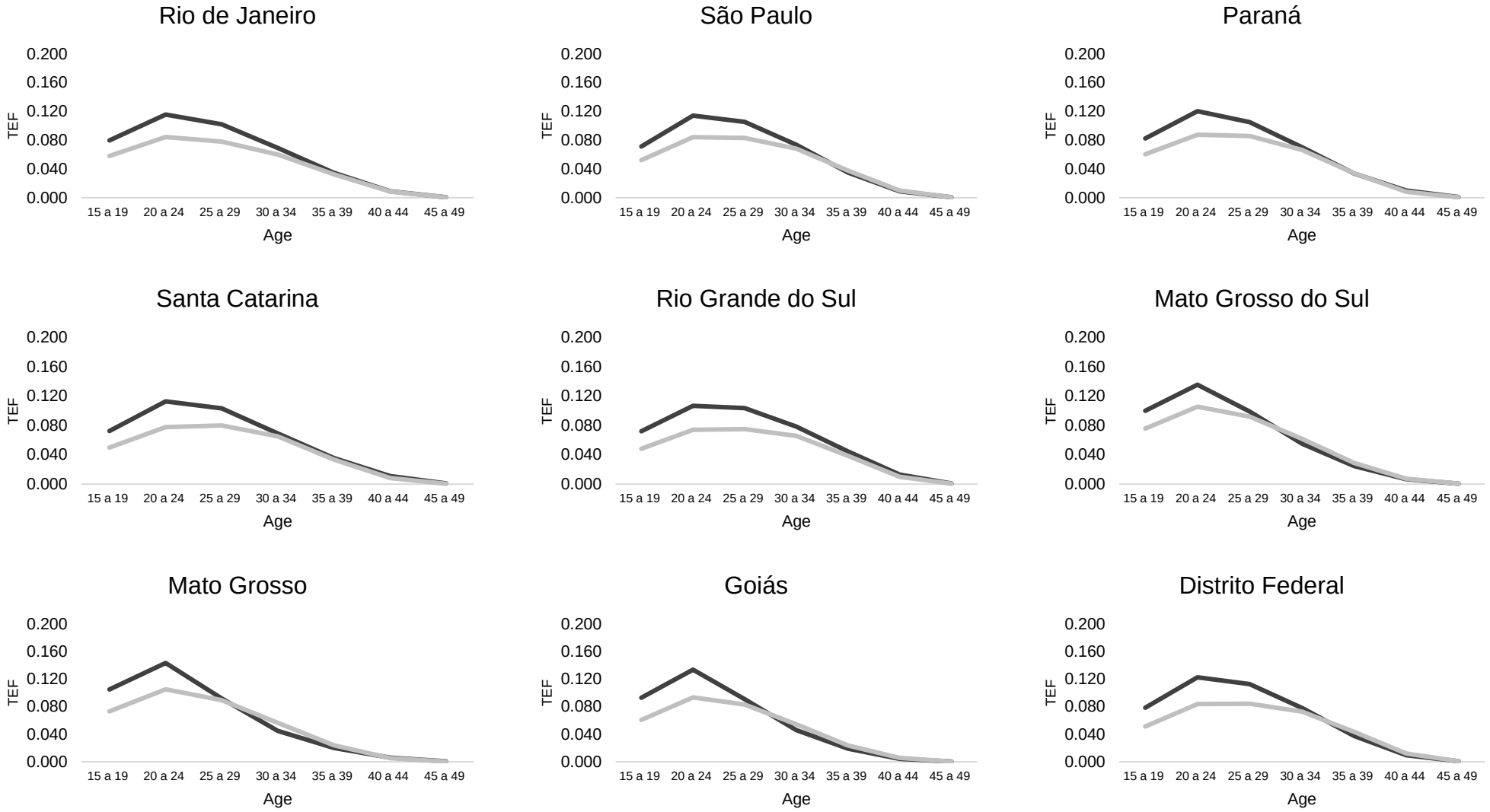
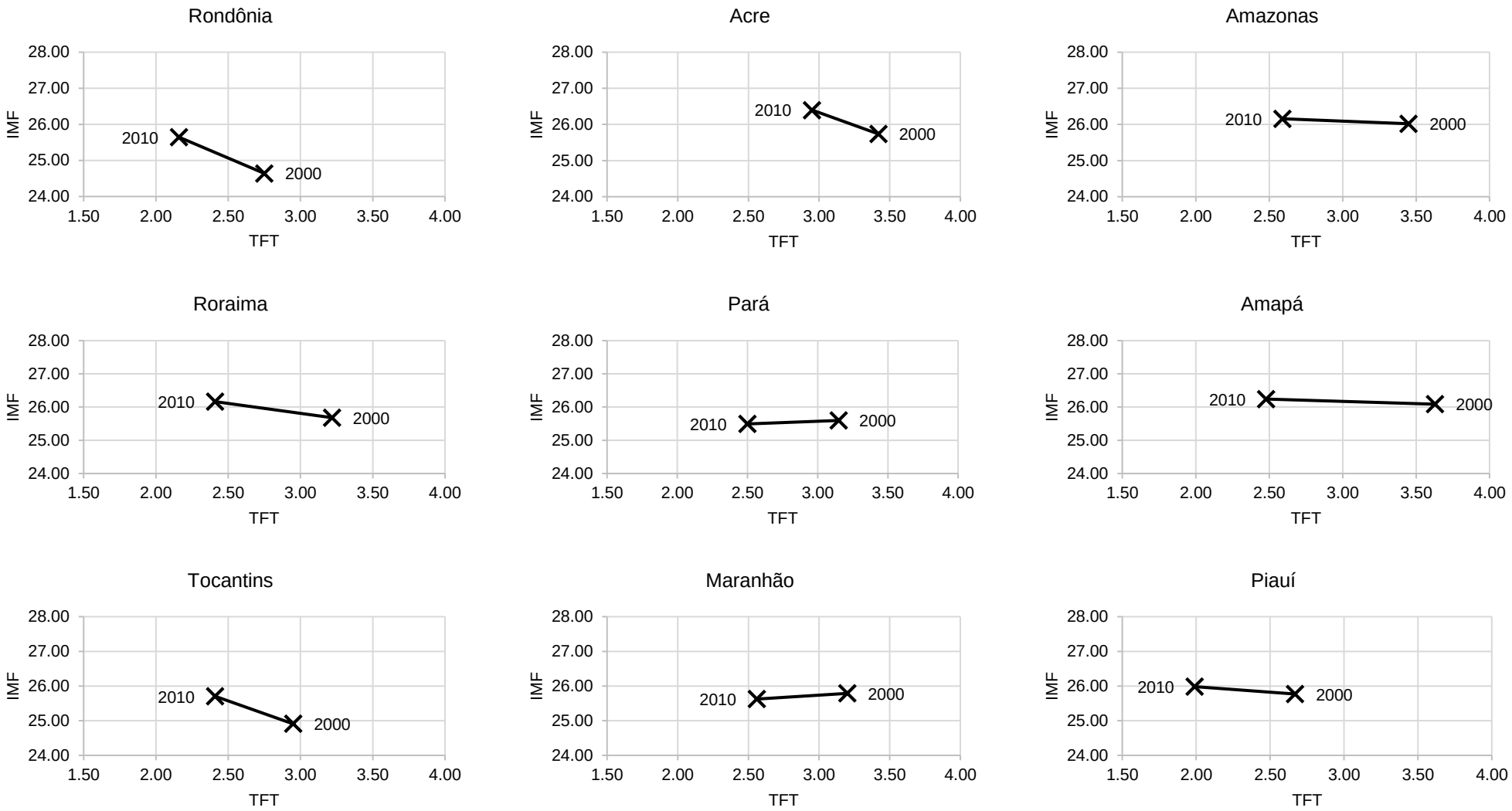


Source: DATASUS, 2018

Figure 3: Relation between Total Fertility Rate and Average Age of Fertility according to Federation Unit. Brazil, 2000 and 2010.



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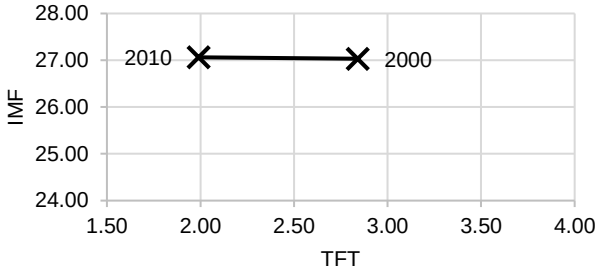

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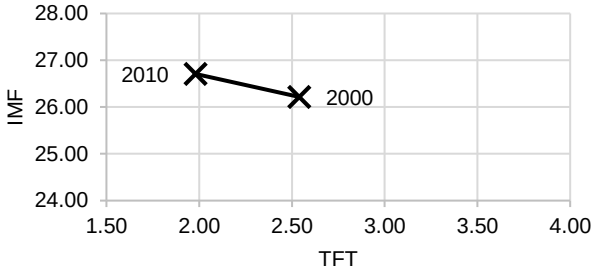

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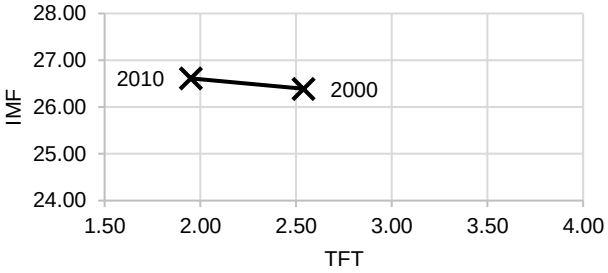

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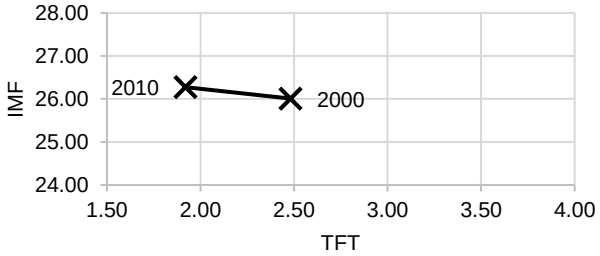

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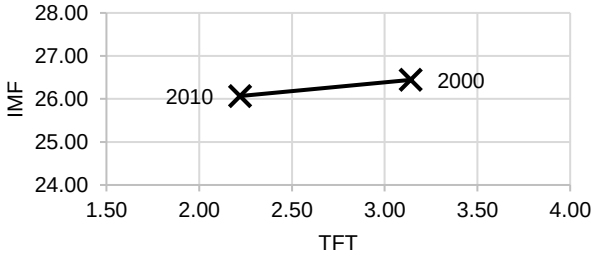

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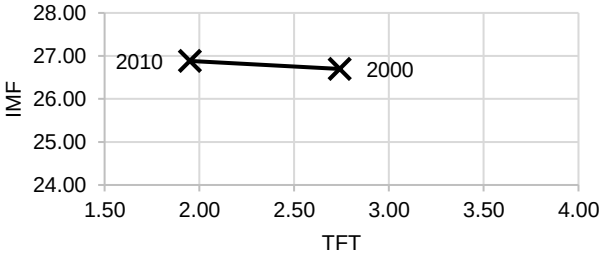

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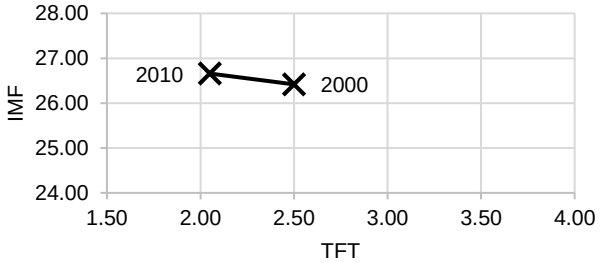

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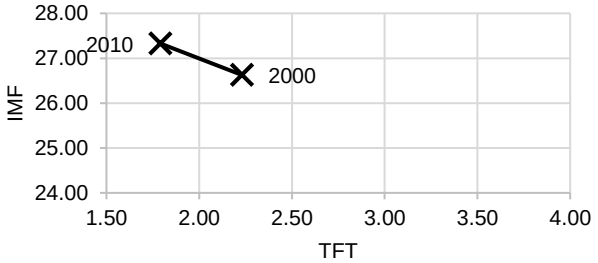

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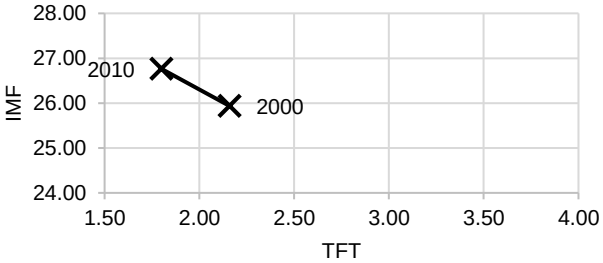

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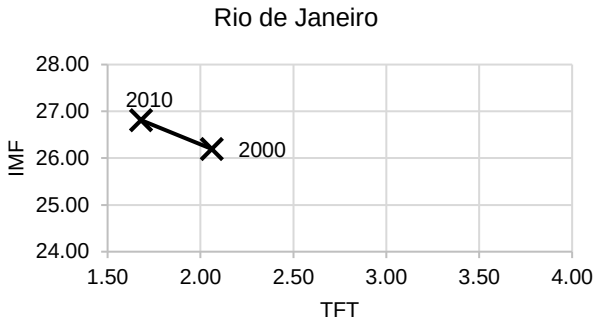

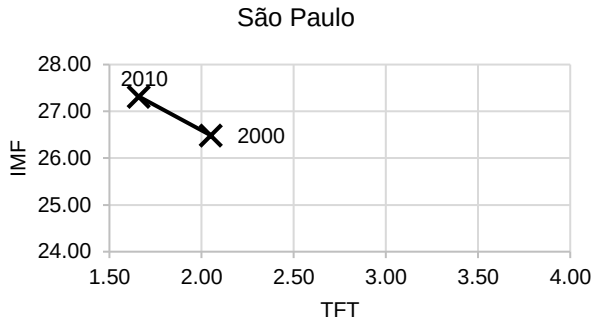

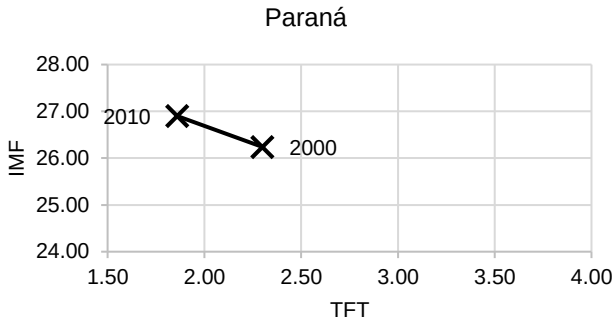

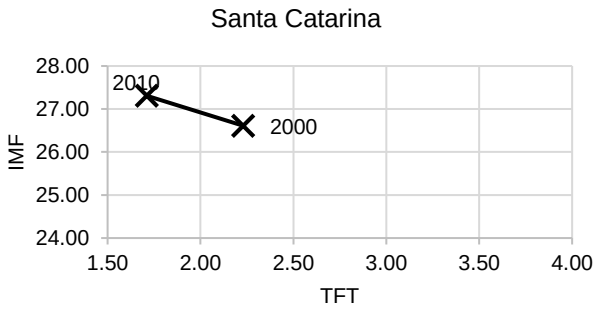

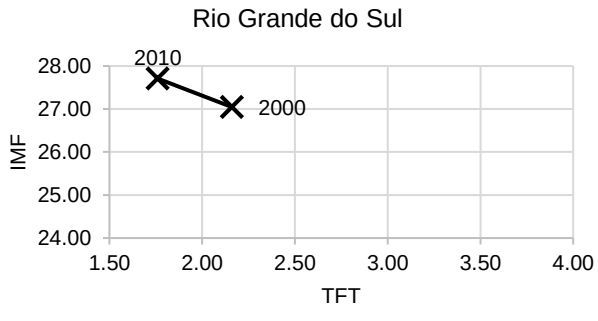

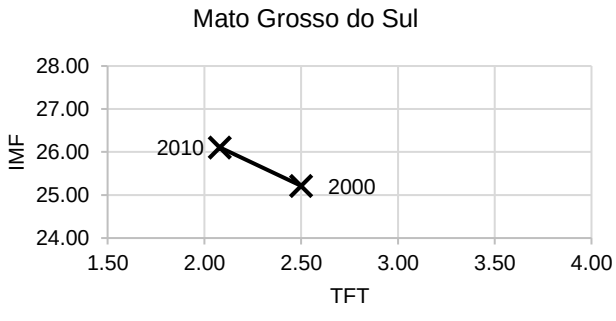

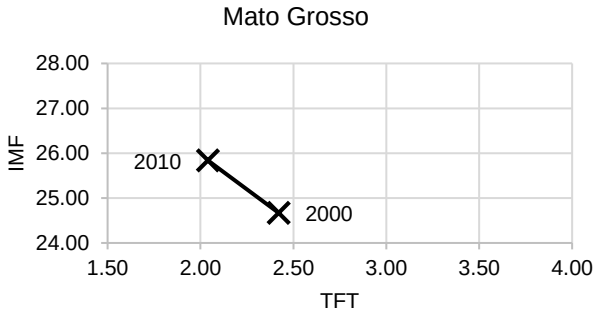

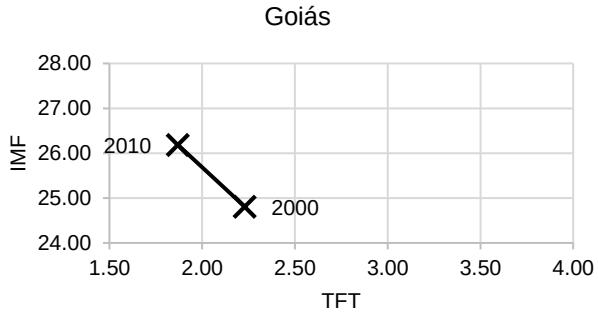

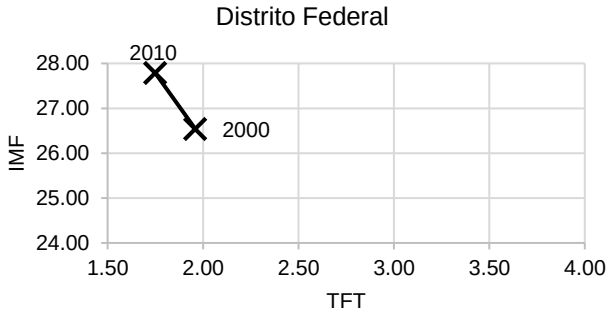

Source: DATASUS, 2018

Table 2: Analysis of correlation between social and fertility indicators (total fertility rate and mean age of fertility). Brazil, 2000 and 2010.

2000							
		10/40 Ratio	Theil	Gini	IDH	TFT	IMF
10/40 Ratio	ρ	1.000	0.972	0.978	-0.649	0.661	-0.325
	p value		<0.001	<0.001	<0.001	<0.001	0.098
Theil	ρ		1.000	0.973	-0.603	0.568	-0.232
	p value			<0.001	0.001	0.002	0.244
Gini	ρ			1.000	-0.632	0.620	-0.246
	p value				<0.001	0.001	0.217
IDH	ρ				1.000	-0.518	0.615
	p value					0.006	0.001
TFT	ρ					1.000	-0.610
	p value						0.001
IMF	ρ						1.000
	p value						
2010							
		10/40 Ratio	Theil	Gini	IDH	TFT	IMF
10/40 Ratio	ρ	1.000					
	p value						
Theil	ρ	0.929	1.000				
	p value	<0.001					
Gini	ρ	0.967	0.938	1.000			
	p value	<0.001	<0.001				
IDH	ρ	-0.771	-0.650	-0.786	1.000		
	p value	<0.001	<0.001	<0.001			
TFT	ρ	0.441	0.287	0.378	-0.281	1.000	
	p value	0.021	0.146	0.052	0.155		
IMF	ρ	-0.121	0.021	-0.098	0.340	-0.119	1.000
	p value	0.546	0.917	0.628	0.083	0.555	

Source: DATASUS, 2018.

DISCUSSION

During demographic transition, the different periods of declining fertility and mortality in different parts of the world have promoted global demographic instability[8]. According to the latest projections of the United Nations, by the year 2100, net migration to each state of the world will be zero, the number of children per woman everywhere (except in a number of countries) will be between 1.8 and 2.2, and life expectancy will be between 70 and 95 years (a much narrower difference than today)[9]. Some Latin American countries have experienced the beginning of the postponement transition since 2000. Among them, Argentina, Brazil, Chile and Uruguay – all belonging to the Southern Cone – appear to be at the forefront of this change[10]. Due to the persistence of high adolescent fertility rates in Latin American countries[11,12], the partial change to late motherhood explains, in some terms, a greater heterogeneity in the age range of first births. Chile and Uruguay, for example, showed the first stages of postponement of fertility with a lower age at first birth and higher standard deviation than developed countries[13]. This pattern is also reflected in the emergence of bimodal curves of first-age-for-age risk rates[13–16].

The fertility rate would have begun to decline under the effect of female schooling. However, the advancement of education does not happen under a vacuum of socioeconomic changes. The postwar period in Brazil was marked by intense socioeconomic changes and by a process of industrialization that stimulated urbanization and thus facilitated the beginning of universalization of schooling, improving the education levels of the population[17]. It is not known, however, exactly how education affected fertility, since outside Brazil it acts on fertility by postponing the age of marriage and increasing participation in the labor market. In Brazil, the first of these did not happen and the extent of the second is not agreed among specialists[7]. Thus, it is unlikely that education has changed fertility profiles without the help of simultaneous transformations in socioeconomic organization[13].

It is important to mention that the scope of theoretical generalization is probably greater in the study of a sustained drop in fertility than in the study of the onset of fertility decline, and in this sense the influence of changes in the level of gender equity may be more evident at this posterior stage[18]. This means that the high levels of participation of women as individuals in combination with low levels of equity for women in their roles as wives or mothers means that many women end up having fewer children than they aspired to when they were younger. The result for society is a very low fertility rate. In this way, the reduction of gender inequality in family institutions is a necessary condition for the fertility transition; otherwise, fertility will continue to be reduced until it reaches the replacement level or falls below it. It should be noted that the improvement of gender relations accelerates the transition process, leading to even lower fertility rates[6,19].

Although new empirical findings and theoretical frameworks provide avenues for explaining the relationship between socioeconomic development, gender equity and

low fertility, many exceptions require a more comprehensive framework to understand the interaction between these processes. It is important to emphasize that the rhythm and the beginning of the development are two important factors to be considered in the analysis of equity of gender and fertility.

More recently, from new cross-sectional and longitudinal analyses of TFT and HDI, a fundamental shift in the well-established negative relationship between fertility and development was observed as the global population entered the twenty-first century[20]. While development continues to promote fertility decline at low and medium HDI levels, at advanced HDI levels, further development can reverse the declining trend of fertility. The relationship of development and previously negative fertility has therefore assumed a new pattern, with HDI being positively associated with fertility among highly developed countries.

It is assumed that this reversal of fertility resulting from continued economic and social development has the potential to reduce the rates of aging of the population, thus improving the social and economic problems associated with the emergence and persistence of very low fertility[21–23]. However, two caveats are required. First, the analysis performed in this direction considered only the composite HDI, and not its components (income, longevity and education). Thus, it is necessary to consider whether the relationship established between HDI and fertility is reversed for all components. Moreover, it should be considered that the study considered a relatively homogeneous group of countries, so that, within the time interval studied, there was no great variation of the HDI in these countries. It is known that the health benefits of educational level are higher in countries with better human development. Health inequalities attributable to schooling are therefore higher in more developed countries[24]. This weakening of the negative relationship between fertility and economic development in many countries, and a positive relationship in some countries, has now been documented[25–28].

Finally, it is important to mention that deep crises or negative phases precipitated in the demographic cycle are almost always followed by “rebounds” or “adjustments” of the demographic system. There is a consensus among researchers and authors that the current low fertility will lead to a gradual recovery[25,29]. The decline in fertility, possibly leading to unsustainable population decline, can be corrected, although the adjustment factors in this case are numerous and probably could not be replicated under different historical circumstances[8]. In this direction, for many years, many countries have insisted on attempts to find public policies for increasing birth rates. However, as Coleman et al[30] pointed out, unlike the factors behind the fall in fertility, the causes of low fertility appear to be beyond the reach of government policy. This is because, as stated earlier, there is a gap between the incentives that generate gender equity in institutions and in the family nuclei[18]. Nevertheless, it is important to think about public policies that fully assist the health of women and their families who opt for gestation in old age, including reorganization of the care network prepared for

this demand with quality, in order to obtain positive results in maintaining the reduction of rates of maternal, infant and fetal mortality.

FINAL CONSIDERATIONS

The revision of theoretical approaches highlights the need to build links between economic, social, political and cultural determinants and demographic aspects, such as fertility. These factors are mainly related to the urbanization process. Data analysis assisted in the recognition of social inequalities that may cause constraints on the desire to have a child in various population groups. It is believed, therefore, that this diagnosis contributes to the advance of predictions in future scenarios on the fertility rate in the country. These results also serve to diagnose and implement health programs and public policies that can ensure rights and access to reproductive health, especially for the most vulnerable population groups.

The fact that the present study shows a relationship still negative for Brazil in 2000, and not significant in 2010, shows that the country is at an intermediate stage in the fertility transition when compared to developed countries.

It is clear that the approach to postponing fertility is important. Some questions emerge from this debate: if the postponement of fertility is already a fact, how can the government prepare the health system in Brazil (SUS) to increase the demand for prenatal care for women of old age? Will high-risk prenatal care (through secondary care) be able to absorb all pregnant women with quality or will some change in the prenatal policy be necessary so that primary care services can see some of these women? Are primary care services prepared to meet this profile of pregnant women? Reproductive behavior and social policy therefore make important links and should be included in women's health agendas.

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