THE SEASONALITY OF 65 MILLION BIRTHS IN BRAZIL – 1997-2018

ABSTRACT

The seasonality of births has been a universal phenomenon worthy of attention since the XVIII century. Exhibiting a variety of forms, many times showing similar patterns in dissimilar societies, and dissimilar patterns in societies alike, there has never been a plausible unifying explanation for their behavior. Finding reasonable causes to understand birth seasonality worldwide is still a challenge. This paper intends to contribute to the discussion on birth seasonality in light of the Brazilian reality, analyzing data about 65,764,313 births from 1997 to 2018 in Brazil. This study investigates monthly birth seasonality, according to social-demographic characteristics of mothers (region, age, race/color, schooling, fertility, and marital status), adjusted to consider the same length for each month of the year. Brazil has two clear periods of birth peaks: the main one is observed in March, April, and May, due to winter conception. A second important peak is observed in September, related to conceptions in December. A clear valley is observed in November and December, due to summertime conceptions. In spite of the continental dimensions of Brazil, its climatic diversity and broad social differences, the Brazilian population presents the same temporal birth distribution, according to geographic spaces and population segments, due mainly to conceptions happening in the Brazilian winter season.

KEYWORDS: Birth seasonality; Sociodemographic factors; Brazil

A SAZONALIDADE DE 65 MILHÕES DE NASCIMENTOS NO BRASIL - 1997-2018

RESUMO

A sazonalidade dos nascimentos é um fenômeno universal digno de atenção desde o século XVIII. Exibindo uma variedade de formas, muitas vezes mostrando padrões semelhantes em sociedades diferentes, e padrões diferentes em sociedades similares, nunca houve uma explicação unificadora plausível para seu comportamento. Encontrar causas razoáveis para entender a sazonalidade do nascimento em todo o mundo ainda é um desafio. Este artigo pretende contribuir para a discussão sobre sazonalidade de nascimentos à luz da realidade brasileira, analisando dados sobre 65.764.313 nascimentos de 1997 a 2018 no Brasil. Este estudo investiga a sazonalidade mensal do nascimento, de acordo com as características sociodemográficas das mães (região, idade, raça/cor, escolaridade, fecundidade e estado conjugal), ajustadas para considerar a mesma duração para cada mês do ano. O Brasil possui dois períodos claros de picos de nascimentos: o principal é observado em março, abril e maio, devido às concepções no inverno. Um segundo pico importante é observado em setembro, relacionado às concepções em dezembro. Um claro vale é observado em novembro e dezembro, devido às concepções no verão. Apesar das dimensões continentais do Brasil, sua diversidade climática e amplas diferenças sociais, a população brasileira apresenta a mesma distribuição temporal de nascimentos, segundo espaços geográficos e segmentos populacionais, devido principalmente às concepções que ocorrem no inverno brasileiro.

Palavras-chave: Sazonalidade de nascimentos; Fatores sociodemográficos; Brasil.

ESTACIONALIDAD DE 65 MILLONES DE NACIMIENTOS EN BRASIL - 1997-2018

RESUMEN

La estacionalidad de los nacimientos ha sido un fenómeno universal digno de atención desde el siglo XVIII. Exhibiendo una variedad de formas, muchas veces mostrando padrones similares en sociedades diferentes, y padrones diferentes en sociedades por igual, nunca ha habido una explicación unificadora plausible para su comportamiento. Encontrar causas razonables para comprender la estacionalidad del parto en todo el mundo sigue siendo un desafío. Este documento tiene la intención de contribuir a la discusión sobre la estacionalidad del nacimiento a la luz de la realidad brasileña, analizando datos sobre 65.764.313 nacimientos entre 1997 y 2018 en Brasil. Este estudio investiga la estacionalidad mensual del nacimiento, de acuerdo con las características sociodemográficas de las madres (región, edad, raza/color, escolaridad, fecundidad y estado conjugal), ajustadas para considerar la misma duración para cada mes del año. Brasil tiene dos períodos claros de picos de nacimiento: el principal se observa en marzo, abril y mayo, debido a la concepción invernal. Un segundo pico importante se observa en septiembre, relacionado con las concepciones en diciembre. Se observa un valle claro en noviembre y diciembre, debido a las concepciones de verano. A pesar de las dimensiones continentales de Brasil, su diversidad climática y sus amplias diferencias sociales, la población brasileña presenta la misma distribución temporal de nacimientos, según los espacios geográficos y los segmentos de población, debido principalmente a las concepciones que ocurren en la temporada de invierno brasileña.

Palabras-claves: Estacionalidad de nacimientos; Factores sociodemográficos; Brasil.

1 INTRODUCTION

Seasonal variation in the number of births has been observed for a long time. The phenomenon is present in almost all parts of the world, from the most poverty-stricken countries and populations to the most affluent societies on the planet, revealing major differences between countries and periods of time, thanks to several factors regulating its existence. Despite such “universality” up to this date there is no unifying acceptable explanation for birth seasonality’s causes, variability and persistency over time. In the past, marital unions, sexual intercourse (and so, reproduction), migrations and deaths were factors known to be demographically regulated by the intricacy of climate conditions, agricultural calendars, food availability, religious precepts, taboos and cultural standards.

The first explanatory studies on birth seasonality in Europe and India identified the climate as the main responsible for the observed increase and decrease of conceptions. Wangertin (1767) called attention to the fact that, on the contrary of what one would expect, there were more conceptions happening in the spring and early summer seasons than in the fall. Moheau (1778) argued that the climate was the first and foremost factor influencing a population, observing a large number of conceptions in June. Villermé (1831) considered the sun positioning related to the earth as the reason for the seasonality of the conceptions. Quetelet (1835) observed that births are less numerous during periods of intense heat. Hill (1888) reasoned the large number of conceptions observed in December in India, with births in September and October, could be due to the greater abundance of food at lower prices in that period.

The observation of birth seasonality began to expand beyond the Europe with the study of Gini (1913), followed by Huntington (1938), but still with a strong focus on the climate. Since then, there have been innumerous studies on the subject.

Several authors, as Dahlberg and Andersson (2019, 2018); Régnier-Loilier (2010); Handrikman and van Wissen (2008), have pointed out a disruption on the idea of climate influence on births given the increase in urbanization, industrialization, secularization and modernization of the society. However, such belief is not sufficient to argue climate does not still play an important role on the phenomenon. Renewed components remark the discussion, including the effects of temperature and photoperiodism on the physiology of reproduction, affecting ovulation and number, and quality of sperms. The average temperature and daily luminosity intensity also affect the frequency of sexual relations, raising the reasoning that environmental, biological and sociocultural factors also can contribute to birth seasonality.

Indeed, there is vast literature connecting environment factors and birth variation along time, e.g. Roenneberg and Aschoff (1990b); Bronson (1995); Lam and Miron (1996); Wehr (2001); Cummings (2002, 2007, 2010, 2014); Foster and Roenneberg (2008); Ruiu and Breschi (2017); and Barreca et al. (2018). Several authors support the role of biological factors as Udry and Morris (1967); Roenneberg and Aschoff (1990a); Rizzi and Dalla-Zuana (2007); Levitas et al. (2013); Santi et al. (2018); Borght and Wyns (2018). Finally, the contribution of socio-cultural aspects on births is put by Roenneberg and Aschoff (1990a); Lam and Miron (1991); Bobak and Gjonca (2001); Handrikman and van Wissen (2008); Herteliu et al. (2015).

Although all these studies have their important share on understanding aspects related to the seasonality of births, none of them taken individually, can explain the phenomenon in global terms. Such gap on the knowledge is recognized by several authors: Seiver (1985); Lam and Miron (1991); Doblhammer et al. (1999); Cummings (2002, 2007, 2010, 2014).

Birth seasonality is of great interest not only to demographers but to epidemiologists as well. The behavior of births along time has a role on the dynamics of the transmission of infectious diseases, as well as in the risks of the presence of a plethora of other diseases and psychiatric illnesses: Torrey *et al.* (1977), He and Earn (2007); Strand *et al.* (2011); Martinez-Bakker *et al.* (2014); Boland *et al.* (2015, 2018); Nasrallah (2019). The month/period of birth affects the causes of death and longevity according to Doblhammer and Vaupel (2001); Gavrilov and Gavrilova (2011); Abeliansky *et al.* (2018); Doblhammer (2019), as later outcomes, as put by Buckles and Hungerman (2013); Boland *et al.* (2015); Isen *et al.* (2017); Dahlberg *et al.* (2018); Bai *et al.* (2018).

Despite of the rich literature on the subject around the world, the need for more studies and analyses, especially focusing on South America is still an issue. This paper is the first in literature to present a portrait of birth seasonality during a period of more than 20 years in Brazil, a southern hemisphere country of continental dimensions. Brazil has the world's fifth largest population and it is marked by wide social and spatial inequalities.

This paper is divided into four sections, including this introduction. Section 2 presents a brief summary of the Brazilian literature on the subject; Section 3 presents the methodology and the data that supports the pattern of seasonal births in the country as a whole and in different spatial and social-demographic cross sections. Section 4 discusses the findings, and Section 5 shows concluding remarks.

2 BRAZILIAN LITERATURE

In Brazil, few papers address birth seasonality as the main subject. Some studies on the health area, related to incidence of disease, may refer to seasonality of births but do not have the subject as the primary focus of the investigation. Martínez et al (1998) studied birth seasonality looking at 6,727 civil birth registers of Rio Grande city, in the period of 1989 to 1994. They e não He observed the highest numbers concentrate on the months of January, February and March, with a secondary peak in October. Mikulecki and Lisboa (2002) investigated the patterns of 5,011 spontaneous births (excluding elective c-sections) observed in Passo Fundo city, from 1997 to 1999, and they found a peak of births in the period of August and September. Giraldelli and Saad (1982) investigated birth certificates in the state of São Paulo, between 1930 and 1980, and failed to identify any remarkable seasonality for the entire period, not even considering 10-year's long intervals. Moreira has discussed about birth seasonality concerning not only about the Northeastern Region of Brazil, but also for the whole country. Regarding the Northeastern Region, Moreira (2010) observed birth records corresponding to the period between 2002 and 2008, and found two major peaks, the first and most prominent happening during the March-April-May quarter (with the highest number in May), and the second, in September. He also found a valley related to the October-November-December quarter (with the lowest numbers observed in December).

Previously, in a paper about birth seasonality in Brazil during the 2000-2005 period, Moreira (2008) had shown that, likewise the Northeastern Region, birth seasonality in the country shows peaks in the March-April-May quarter, corresponding to the Fall season, with the highest numbers observed in March. A secondary peak in September as well as a valley in the Spring season (October-November-December quarter), with the lowest numbers happening in December, could also be observed, matching the same behavior as the Northeastern birth time series. These results corroborate the idea of non-existence of differentials in the regional seasonality patterns. Exception can be observed for the case of the Northern Region, where a birth peak is observed in September. While the Northern region presents a peak in September, all the remaining regions present a peak in the Fall season. Particularly, the Northeastern region presents the highest numbers in May, while the South, Southeast and Midwest of Brazil observe the highest peak in March. Moreira also calls attention to the fact that, according to the 2010 Brazilian population census, only 8.3% of the Brazilian population lives in the Northern region. Furthemore, no peak differentials have been founded when disaggregating the series by mother's age group, education, marital status, and parity, but December remains as a valley for all categories. The longer period of 2000-2010 analysis (MOREIRA, 2012; 2013) reassures previous findings regarding the national seasonality level: a peak in the fall quarter, a secondary peak in September and a valley in the spring.

3 METHODOLOGY AND DATA

This descriptive study aims to describe birth seasonality in Brazil, based on secondary data registered in the period 1997-2018 disaggregated by regions and sociodemographic characteristics of mothers. This paper considers data from the Sinasc – Live Birth Information System which is the official information system on live births from the Ministry of Health, and corresponds to a monthly time series of living births starting from January 1st, 1997, and ending at December 31st, 2018, summing up 65,764,313 records in the period.

The Sinasc has gradually been implemented in the Brazilian states since the 90s. It is composed by administrative records of live births occurring in health institutions or assisted by doctors or personnel recognized by the Brazilian health system. Births are registered by means of a DN (Declaration of Living Birth), which is issued upon a child's birth and is also a document with legal standing for obtaining a birth certificate from the Civil Records' Office. Declarations of Living Birth are filled out by qualified health professionals, in the case of births in hospitals, or home births assisted by health professionals, or yet by traditional midwives duly acknowledged by the health system. Such Declarations contains data from the patient's medical records as well as data informed by the mother of the newborn. Typically, these data consist of birth related information such as date, place, health institution, and city of birth. It also includes mother's name, age, marital state, education, profession, number of living born children, number of fetal losses and abortions, and city of residence. Considering the pregnancy and childbirth, it registers information about the length of gestation (in weeks), type of pregnancy, type of childbirth, and number of prenatal appointments. Regarding the newborn, there is data concerning gender, race/color, Apgar score in the first minute, Apgar score in the fifth minute, weight, congenital anomalies, and congenital anomaly code, according to ICD – (International Classification of Diseases). Improvements on the Sinasc system were achieved over time, with additional information regarding the father as well as the register of color/race of the mother were introduced to the DN. Items were also modified, such as marital status and education, to comply with changes in the Brazilian legislation. The Sinasc national rate of coverage has also been growing considerably along the years, reaching 90% around the year 2000, and 100% between 2012 and 2013. This can be explained by a high rate of births, of approximately 98%, happening in hospitals, according to Civil record data (ALMEIDA et. al, 2009; IBGE, 2017).

This paper considers mother's region of residence, mother's age and race/color, education, parity and marital status as variables of interest, all informed by the mother herself or based on their hospital records, verified at the time of the birth. Data about region of residence can assume the values of any of the five major Brazilian regions: North, Northeast, Southeast, South and Midwest. The age of the mothers ranges between 10 and 39, and is listed in five-year intervals, with a ten-year interval for women aged 40 to 49. Race/color categories are white, brown, yellow, black and indigenous. It should be noted that birth series by mother's race/color only began in 2012. Before that, information regarding race/color only referred to the living born baby. Data about mother's education have four categories: (i) *none, or almost none*, comprising women who never went to school for a whole year, or who only finished the first grades of primary school (currently five years); (ii) *low*, comprising those who finished or not the four final grades of fundamental education; (iii) *average*, women who went to high school or finished high school; and (iv) *superior*, women who went to college or finished college. Due to major differences in the way information was collected in previous years, the birth series considered for classifying mother's education starts at year 2000. Finally, parity is considered as the mother's number of previous living born children, and marital status corresponds to herself declaration, with possible answers being single, married or in a stable union, or WDS. This last category (WDS) corresponds to anyone who is either widowed, divorced, or separated. The series on marital status refers only to the period from 2012 to 2018, to keep homogeneous definition of consensual unions.

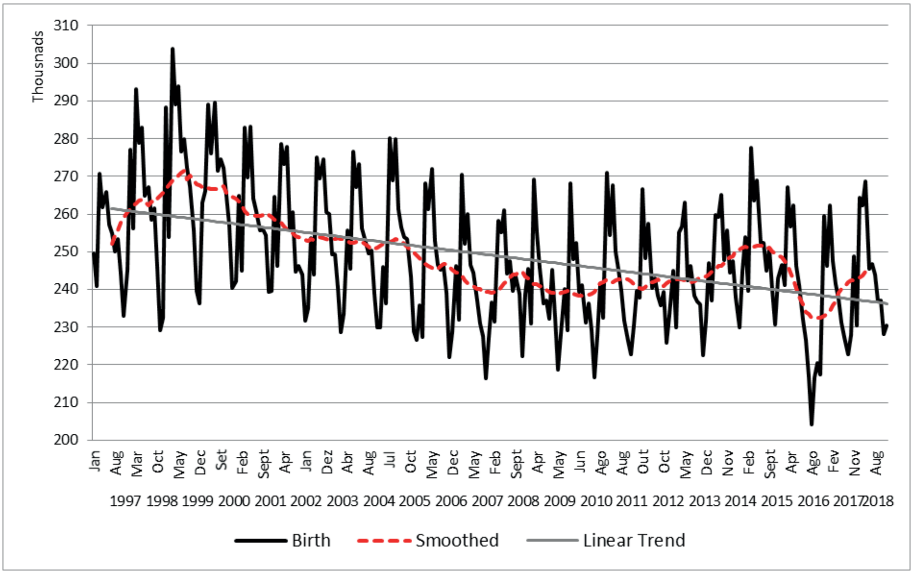
In this paper, the data of monthly births was adjusted to consider an equal duration for every month of the year.

4 RESULTS

Chart 1 shows the time series of births from 1997 to 2018, along with a smoothed birth time series version, based on a 12-month moving average, and a linear trend.

The growing number of births in the first part of the series is due to the broadened coverage of the Sinasc data collection over the country. It also calls attention the massive drop in the number of births in the second semester of 2016, a reflection of the impact of the Zika virus on the reproductive behavior of the Brazilian population (MARTELETO et al., 2017).

Chart 1- Brazil – Birth time series, smoothed birth time series (12-month moving average) and linear trend – 1997-2018



Source: MS/SVS/DASIS - Live Birth Information System (Sinasc) – 1997-2018.

Time series, as well as indirect methods' results, show an increase in the number of women of reproductive age (15-49 years of age), from 44.5 to 57.0 million, between 1997 and 2018. They also show a fall in the total Brazilian fertility rate, decaying from 2.47 children per woman, in 1997, to 1.77 children per woman in 2018 (IBGE, 2016, 2013).

Brazil is one of the countries with the greatest drop in the levels of fertility over the last decades, currently standing lower than the replacement level. This fact is remarkable considering the fertility rate was in the range of 2.5 children per woman, 20 years ago. This decline is observed for every layer of the society, in all regions of the country.

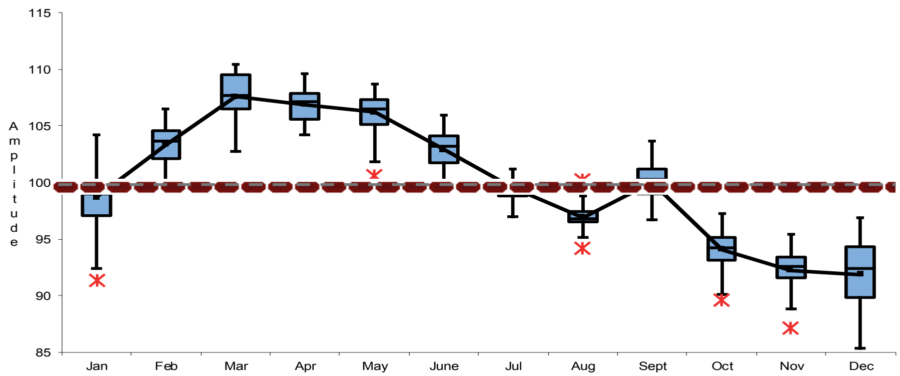
The trend towards having fewer children can be explained by an increasing number of women preferring either having no child, or an only child, or at most two children, in Brazil.

This significant drop in the national levels of fertility in such a short period of time is rooted in the process of empowerment of the Brazilian women, which means greater control over reproduction, regarding not only deciding how many children to have, if any, but also when to have them. Underlying such a fertility control level is the dissemination of birth control methods[1], and the cost of opportunity to have children. New life styles aspirations, inherent to the preeminence of women's personal satisfaction, compete with the traditional profile based on cohabitation and reproduction. The result is a new reality, observed nationwide, characterized by the reduction of the number of children per woman, the increase of the proportion of women without children, the increased space between births, and the extension of the age limit for having children. Pushing up the age limit for having children, and opting for having no children, are modern traces of Brazilian women with a higher level of education and income. Such traces are practically non-existent among younger women who, despite starting to breed earlier, would tend to wrap up the process earlier than their predecessors' generation.

In Chart 2, the monthly amplitude of births in the period from 1997 to 2018 (amplitude being the percentage deviation related to the annual monthly average) and the box plot for the adjusted months to make them all have the same length during the year show two birth peaks in Brazil; one, more expressive and longer, takes place in March, April and May - autumn in Brazil; the other, a secondary peak, is less pronounced, and takes place in September. The valley, with a higher deviation than the peak, takes place in November-December - spring in Brazil.

1 United Nations estimates (2018) indicate that 76.8% of Brazilian women aged 15-49 use modern birth control methods and 2.9% use traditional methods.

Chart 2 - Brazil - Amplitude and box plot of monthly births - 1997-2018



Source: MS/SVS/DASIS - Live Birth Information System (Sinasc) – 1997-2018.

Births in the March-May peak are the result of conceptions in June-August - winter in Brazil, as well as the short mid-year vacation - and births in September, the secondary peak, are the fruit of conceptions in December - the Christmas and New Year holiday season. The small number of conceptions in the months of the Brazilian summer, which is also the period of summer vacation and carnival, is responsible for the lower number of births in the three-month period of October, November and December. Even though cultural events, such as holidays and carnival, are not considered in this study as an explanation for birth seasonality in Brazil, they can be seen as social-cultural factors related with the phenomenon in question, but, in this case, mainly as popular beliefs. Since, contrary to what popular beliefs would have us expect, no increase in the number of conceptions during the periods of carnival and vacations was observed, as found by Kadhel et al. (2017) in Guadaloupe. The higher temperatures typically registered during this period in Brazil and the increased practice of birth control are possible reasons for the lower number of births.

As for the impact of climatic diversity and social inequality in Brazil, there is no significant difference in birth seasonality according to the social-demographic characteristics and spatial localization of the mothers, as shown by the data in Table 1.

Table 1 - Brazil – Amplitude of monthly birth distribution by region and the social-demographic characteristics of the mothers – 1997-2018

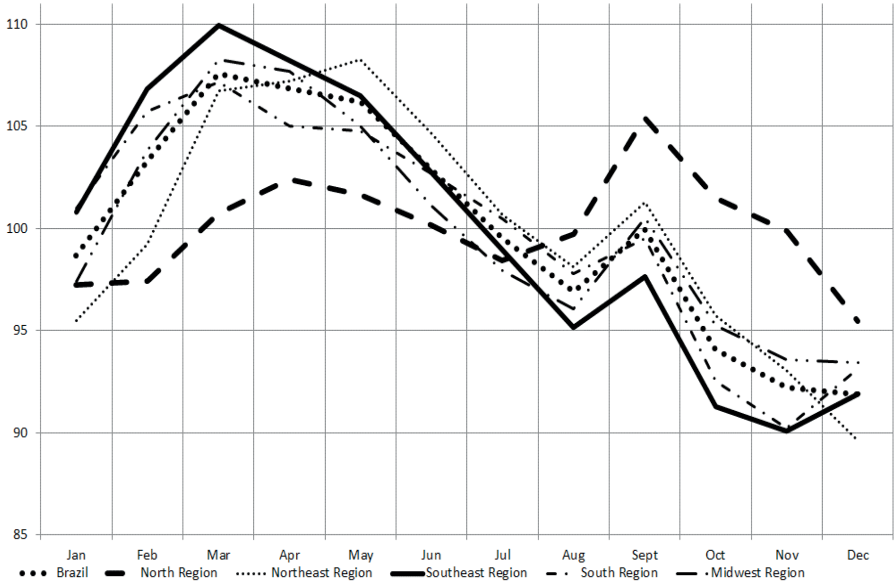
	N of cases	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
Brazil	65,764,313	98.7	103.3	107.6	106.9	106.2	102.9	99.5	96.9	100.0	94.1	92.2	91.9
Regions													
North Region	6,710,191	97.2	97.4	100.7	102.4	101.6	100.2	98.4	99.7	105.4	101.5	99.9	95.5
Northeast Region	19,097,172	95.5	99.2	106.7	107.2	108.2	104.6	100.7	98.1	101.3	95.8	93.1	89.6
Southeast Region	25,825,399	100.8	106.9	109.9	108.2	106.5	102.7	98.9	95.2	97.7	91.3	90.1	91.9
South Region	8,835,724	101.0	105.7	107.1	105.0	104.8	102.7	100.5	97.8	99.5	92.5	90.2	93.2
Midwest Region	5,094,763	97,4	103,8	108,3	107,7	105,0	101,1	97,9	96,1	100,5	95,2	93,6	93,4
Age Groups													
10-14 years	590,823	95.4	99.7	105.2	106.3	105.8	105.1	102.1	101.6	102.6	95.4	91.3	89.5
15-19 years	12,928,195	98.2	101.9	106.7	106.5	106.1	104.0	100.3	98.6	101.2	94.3	91.9	90.3
20-24 years	18,746,666	99.3	103.4	107.5	106.6	106.0	102.6	99.4	96.9	100.0	94.2	92.6	91.5
25-29 years	14,897,079	99.3	104.1	108.0	107.1	106.0	102.1	98.9	96.1	99.6	94.1	92.3	92.5
30-34 years	10,825,295	98.1	103.7	108.0	106.9	106.0	102.4	99.2	96.2	99.7	94.1	92.3	93.3
35-39 years	5,388,705	96.9	103.2	107.7	107.3	107.0	103.4	99.6	96.3	99.1	93.7	92.2	93.5
40-49 years	1,451,701	97.4	102.3	106.7	107.1	107.5	104.9	101.4	97.3	98.0	93.6	91.8	91.9
Mother's Race/Color *													
White	7,210,483	98.0	104.6	107.8	107.1	106.7	103.3	100.4	97.0	98.6	92.6	90.6	93.2
Brown	10,908,480	96.5	101.2	105.3	106.6	106.5	102.1	99.5	97.0	99.9	95.7	95.1	94.6
Asian	79,639	95.6	102.9	107.9	104.3	105.5	100.5	102.4	98.1	98.0	94.8	94.7	95.2
Black	1,081,233	97.7	104.5	107.3	107.3	106.7	102.2	98.5	96.2	98.0	92.6	93.6	95.4
Indigenous	224,701	98.2	98.8	100.8	102.7	102.8	99.4	99.4	100.8	104.6	98.7	98.6	95.4
Education Level **													
None and too low	5,399,551	105.5	106.8	108.5	107.2	107.7	103.7	99.5	97.2	97.4	91.6	89.5	85.3
Low	15,506,149	98.7	103.6	108.1	108.0	107.3	103.7	99.8	97.2	98.8	93.4	91.5	90.0
Average	25,323,529	96.8	101.6	107.0	106.4	106.1	102.4	99.3	96.9	100.1	94.9	93.7	94.7
Higher	8,144,901	96.7	102.6	107.2	105.2	104.7	101.7	99.6	96.4	102.3	96.0	92.3	95.3

Parity													
None	22,831,038	97.3	102.4	106.6	105.7	105.3	102.7	99.9	97.1	101.3	95.1	93.0	93.4
1 children	19,243,425	98.8	103.8	107.9	107.0	106.2	102.6	99.3	96.3	99.6	94.0	92.3	92.3
2 childrens	9,280,533	99.3	104.3	108.5	107.5	106.6	103.3	99.1	96.6	98.6	92.8	91.8	91.6
3 childrens	3,920,078	99.5	104.0	108.2	107.0	106.7	102.9	99.3	97.5	98.8	92.9	92.1	91.2
4 or more childrens	4,057,382	100.5	102.7	106.5	105.9	106.2	102.9	100.6	99.0	99.7	94.2	92.1	89.6
Conjugal Status*													
Single	8,508,266	98.0	102.6	106.3	106.6	106.8	102.6	99.9	97.5	99.1	93.7	93.3	93.7
Married	6,700,947	98.1	104.3	107.5	107.1	106.5	102.4	99.2	95.8	98.7	94.2	92.2	94.0
WDS***	263,377	98.3	104.0	106.9	106.9	108.2	102.2	98.4	95.8	98.4	93.7	92.2	95.0
Stable union	4,732,148	98.0	101.2	106.1	106.3	106.0	102.1	99.7	97.4	99.8	95.5	94.1	93.8

Source: MS/SVS/DASIS - Live Birth Information System (Sinasc) – 1997-2018. Remarks: 1) Total less than 100% due to not considering all categories (as age) and/or due to absent information (as parity). 2) * Refers to 2012-2018. 3) ** Refers to 2000-2018. 4) ***WDS comprises Widowed, Divorced and Separated.

The data in Table 1 and Chart 3 show that, regarding birth seasonality based on the population's spatial location, the North (the Brazilian Amazon) is an important exception to mention, since it presents a birth peak in September, in contrast with the other regions of the country, where September is the month of the secondary peak. The North also presents the lowest difference between the peak and the valley, and is the only region which, comparatively, presents a shallow variation in the monthly birth distribution throughout the year. This is to be expected among populations near latitude zero and where there are only two seasons: the dry season (no rain at all) and the wet season (the rainy season) and the lowest levels and lowest monthly variations of insolation. The North undergoes maximum solar luminosity from June to November, during the dry season, and the minimum luminosity occurs from December to May, which is the wet season, when there are more clouds covering the sky. The period of transition from the rainy season to the dry season, and vice-versa, is very short (TIBA, 2000; RAMOS et al., 2009). Therefore, this particularity with regards to the birth peak in September shows the relative significance of the period of celebrations and festivities towards the end of the year for birth seasonality in the North.

Chart 3 - Brazil and regions - Amplitude of monthly births - 1997-2018



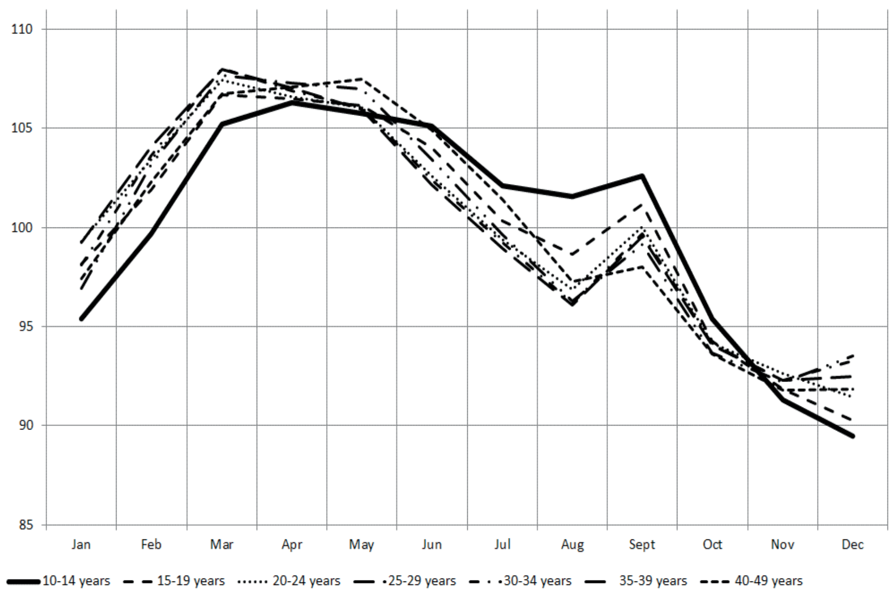
Source: Table 1

The Northeast (between latitudes 2º and 16º S), despite being located approximately at the same latitude as the North (between 5º N and 12º S), presents a discrete spatial configuration based on the two predominant climates: semi-arid, the largest portion of the region, characterized by frequent long dry spouts in the interior of the region, and wet, along the coast line, where most of the people live. The levels of insolation in the Northeast are the highest in the country, with little variation throughout each year. From October to December, solar radiation reaches its highest levels, in contrast with June and July (TIBA, 2000; RAMOS et al., 2009). The amplitude between the peak and the valley of births in the Northeast Region is the third highest in the country. In this region, contrary to the others, not only does the birth peak take place in May, but it also maintains high levels during the months of March and April, due to conceptions during the winter months of June, July and August, when insolation is lower (AGUIAR, 2003).

In the other Brazilian regions, the South, Southeast and Midwest, births are more numerous in March (conception in June, the beginning of winter) and, particularly, only the Midwest maintains a similar birth rate between the peak month (March) and the following month. The South and Southeast have a similar annual distribution, with the only differences being that in the Southeast, births are more concentrated in the first semester, and the monthly variations are more expressive, with the second-largest difference between the number of births in the peak and valley. The birth distribution in the Midwest is intermediary, compared to that of the South and Southeast, with the temporal pattern of births closest to that observed in the country as a whole. In the Southeast, the region that is home to 40% of the Brazilian population, insolation is at its highest in July and at its lowest in September. The South, located between latitudes 22º e 33º S, presents the highest insolation between December and February, and the lowest in the period from June to August. (WREGE et al., 2012).

The results of temporal birth distribution according to the Brazilian regions show that, with the exception of the North, differences in latitude have no significant impact on birth seasonality in Brazil, with no expressive variations observed in the birth calendar as one moves from the north to the south in Brazil. Notice that the boundary of the series in the North and Southeast encompass the largest fraction of the trajectories of the remaining social-demographic and spatial cross sections. Chart 4 shows the temporal birth distribution, according to the mothers' age group.

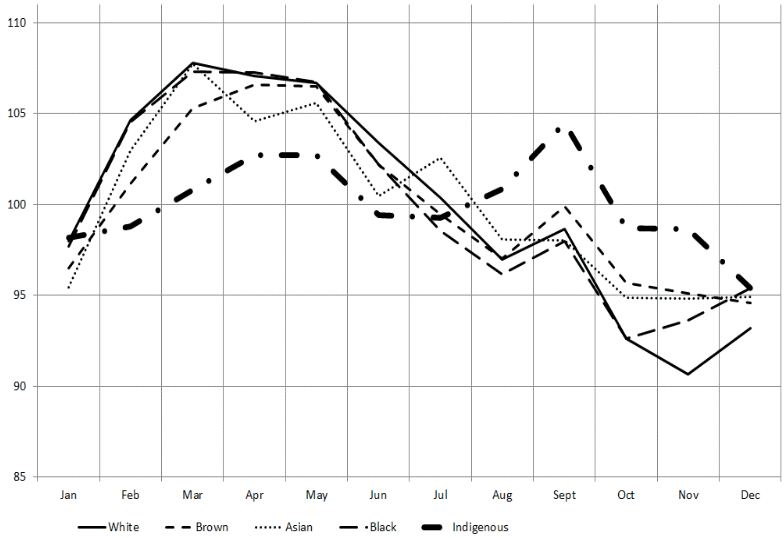
Chart 4 – Brazil – Amplitude of monthly births, by mothers' ages – 1997-2018



Source: Table 1

Regarding age groups, births of young mothers, ages 10-14, and women at the end of their reproductive life peak in April and May, respectively, while the remaining groups peak in March. The main difference between these two groups at opposite ends of the reproductive cycle is due, in the case of very young mothers, to their social vulnerability, social exclusion and sexual coercion, prostitution and child abuse, as additional factors that are a part of their reality (MINISTÉRIO DA SAÚDE, 2018). The relative stability of births, particularly throughout the period covering from March to September, vis-à-vis the remaining groups of ages, reflects the character of these undesired births. Births among young women in the 15-19 age group are partially due to the same reasons of those in the first group, but, in terms of violence and abuse, in much lower proportions. `Free time and lack of any worries` during the short school vacations, associated with the levels of poverty, the desire to leave home and social vulnerability are the main elements that explain this difference. It must additionally be considered that, in Brazil, particularly, teenage fertility presents significant differences among social strata, and is markedly higher among young people in the less privileged segments, comprising people with very little schooling. For the older group ages, the temporal trajectory in the reproductive process is very similar, especially among women in the 20-34 age group, and the trajectory of the 35-39 age group is not much different. Chart 5 shows the temporal birth distribution, according to the mothers' race/color.

Chart 5 – Brazil – Amplitude of monthly births, by mothers' race/color – 1997-2018



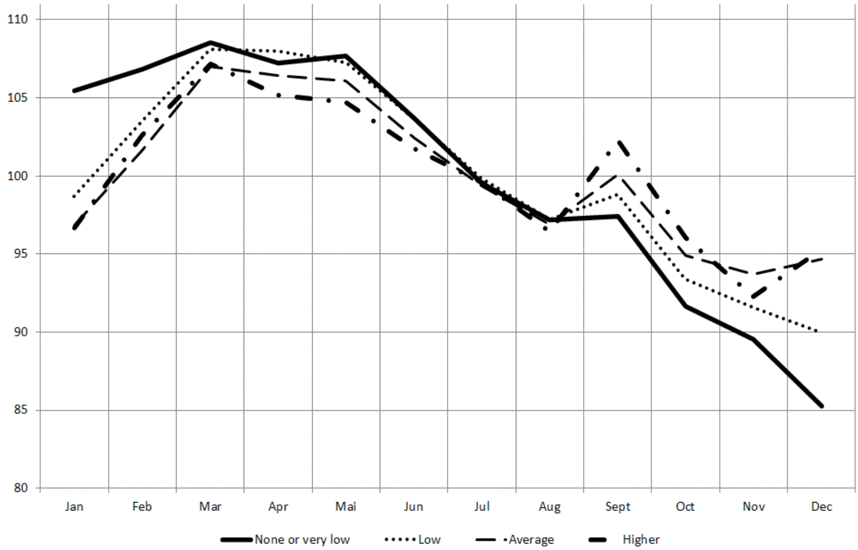
Source: Table 1

The birth calendars of white and black women are very similar. On the other hand, the majority composed of women who declare their color as brown present slight differences from the trajectory of the white and black women (a little more in the case of the black group than that of the white group), presenting, in relative terms, fewer births in the first semester of the year; a delayed and longer peak (April-May, as opposed to March for the white women and March-April for the black) and a higher proportion of births in the secondary peak in the month of September.

From 445 thousand indigenous women surveyed in 2010 Census, the number of births registered by Sinasc during the period reaching from 2012-2018 is 220 thousand. The ethnic diversity of the Brazilian indigenous population (305 ethnic groups speaking 274 languages), along with the relative scarcity of studies regarding the reproductive behavior of this population or the number of cases registered in the system, requires caution when evaluating the indigenous birth seasonality. The trajectory revealed by the available data is that of a smooth temporal trend, compatible with high rates of fertility and population growth, especially among the rural population, a concentration of births among the very young, and reduced deliberate fertility control very close to the trajectory of the population in the North, where most of them reside (37.4% reside in the North), followed by the Northeast (25.5%) (PEREIRA et al., 2014; IBGE, 2012; AZEVEDO, 2009).

The number of births among the yellow population (people of oriental origin: Japanese, Chinese, Korean and their descendants) is very low, with an irregular trajectory. Chart 6 shows the temporal birth distribution, according to the mothers' schooling.

Chart 6 – Brazil – Amplitude of monthly births, by mothers' schooling – 1997-2018



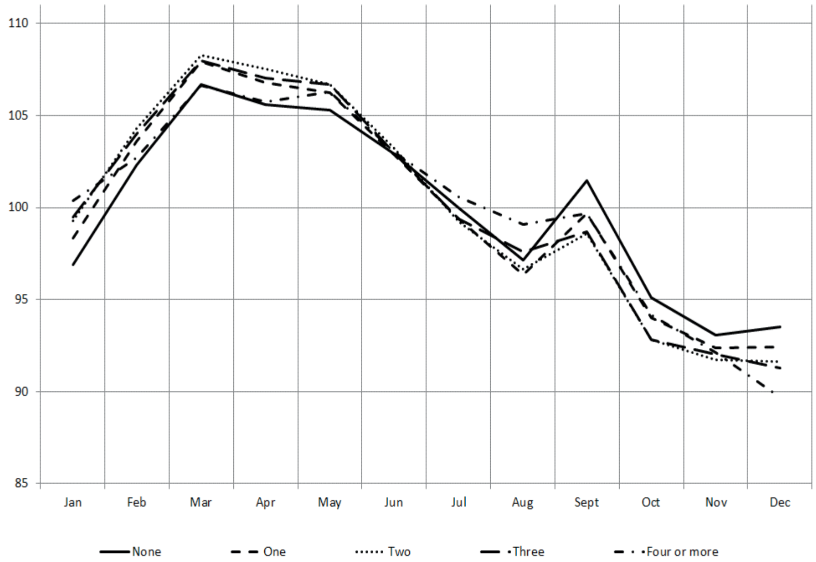
Source: Table 1

In the 2000 decade, as well as throughout the 2010s, enrollment grew and dropout rates fell expressively in all levels of schooling, with a drastic reduction of the proportion of the population outside the school system. Consequently, the index of national illiteracy became concentrated among the older age groups and people living in conditions of extreme poverty. The main cause for the increase in schooling in Brazil was the significant broadening of the superior level of education, with women outdoing men in the number of enrollments, including post-graduation courses.

Considering the mothers' schooling, data from 2000-2018 does not show a significant difference between women with a university degree and those with average or even low schooling: all of them show a birth peak in March; however, those with a higher level of education are concentrated in the month of March, while those with a lower and average level of schooling extend the peak to April and May.

A characteristic of the group of women with a higher level of education is the one with the highest proportion of births in the secondary peak in the month of September, suggesting a higher proportion of weddings/conceptions in December for this group. On the other hand, the temporal trajectory of births among women with very little or no education at all is particular. This fraction of the Brazilian population is still quite numerous among mothers (9.8% in the period 1997-2018) and births are concentrated in the first half of the year, with no significant monthly variation in the first third of the year. From then on, the number of births falls drastically. This group differs from the other schooling groups by the flat line of births in the first five months, the speed of the downward trend in the rest of the year, the absence of the secondary peak in the month of September and the amplitude of the proportions of births in the peak month compared to the valley month, the highest in the country. Chart 7 shows the temporal birth distribution, according to the mothers' parity.

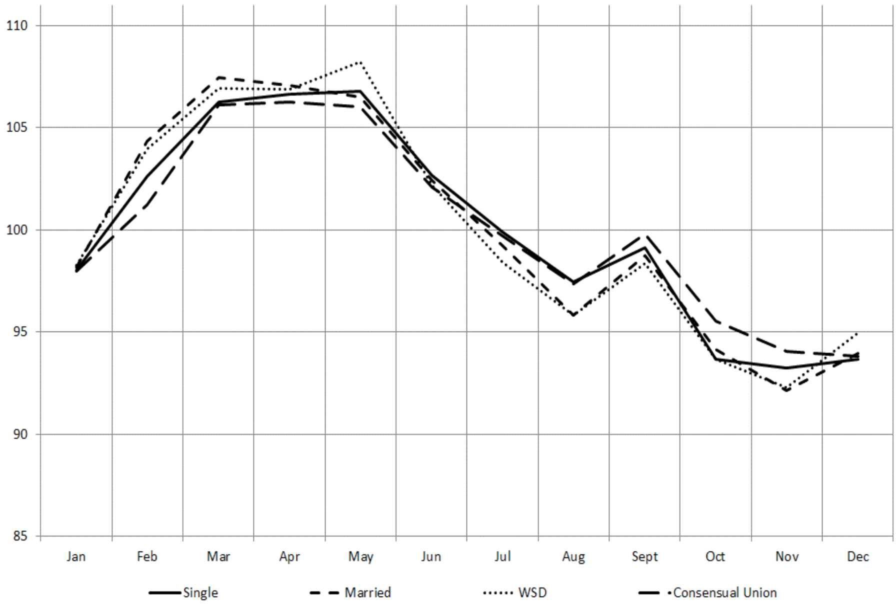
Chart 7 – Brazil – Amplitude of monthly births, by mothers' parity – 1997-2018



Source: Table 1

Regarding parity, no differences were observed among the groups in the peak month. All women, regardless of their parity level, have births predominantly concentrated in March. Movements are very similar among all levels of parity, with slight differences in the extreme groups, with single-child women more concentrated in one month (March) and those with over 4 babies extending the more intense reproductive period from March (peak) to May. A relative difference according to the order of birth rates reveals a different behavior for women giving birth to their first child. These present a milder temporal distribution and a higher concentration of births in the month of September, suggesting that the births of the first child may be the result of choice, and that a significant fraction of these births are associated with the month of the wedding. If one takes into consideration the fact that there is a progressive trend in Brazil to move weddings from the traditional month of May to December, it is possible to assume that the conceptions of this population are following this change, at least in part. Chart 8 shows the temporal birth distribution, according to the mothers' marital status.

Chart 8 –Brazil– Amplitude of monthly births, by mothers' marital status – 1997-2018



Source: Table 1

There is no evidence of variations in birth seasonality caused by the mothers' marital status. One must consider, however, that since a mother's marital status is self-declared, there is likely to be inaccurate information. This phenomenon can be observed in the results of the 2010 Brazilian Demographic Census, when 6.7% of the women over 10 years of age declared they were married, but were not in union; 15.4% of those who declared they were separated, widowed or divorced were living in union, and 28.1% of those who said they were single were actually living in a union.

In short, with the exception of the North, Northeast, Southeast and South, women in the 25-29 and 30-34 age groups, those who declare their color as being white or yellow, the indigenous, those with higher education, single-child mothers and those giving birth to their second or third child, for all the remaining cross sections the period involving the birth peak goes beyond the maximum month. In these cross sections, whether the peak and the following months last for two, three or four months, the interval comprises the months of March, April and May. Present in 25 of the analyzed segments, the month of March fails to appear in the peak interval in only six groups of populations: In the North, in the Northeast, 10-24 years, brown women and indigenous women and WDS. Most of the births in Brazil take place in the first semester of the year, with the peak predominantly in the month of March, for 22 of the analyzed categories, in April for three of them, four, in May, and two others in September. As for the valley, it appears in December (15 categories), the same in November (15 categories), and October (one category). There is a relative homogeneity in the temporal birth distribution among the regions of Brazil, and among the social-demographic characteristics of the mothers. The trajectories of the population of the North are relatively discrete, as well as those that involve less fortunate fractions of the Brazilian society, composed by 10-14 years, indigenous women and women with very little schooling or no schooling at all.

The findings of this paper corroborate those of Moreira (2008, 2013), regarding Brazil, for two discrete moments, herein considered. The group of findings suggests that, in spite of the continental dimensions of Brazil and its climatic diversity and social inequalities, the reproductive behavior of the Brazilian population is similar in terms of temporal birth distribution, concentrated in March, April and May for different segments of the population, except for the population of the North and the indigenous population, with a birth peak in September. Births during the March-May period are the result of conceptions during the Brazilian winter, while births in September are the result of conceptions during the Christmas and New Year festivities, whereas the valley during October-December derives from conceptions in the summer.

5 CONCLUSION

Brazil is a country of continental dimensions, with considerable fractions of its population located in discrete latitudes, with significant differences in climate and marked by profound social inequality. Even so, the reproductive behavior of the Brazilian population is very homogeneous, in terms of temporal birth distribution. The only exceptions are those found in the North (the Brazilian Amazon), with a birth peak in September and a more homogeneous temporal trajectory. For all other segments of the Brazilian population, births are concentrated in March, April and May, with a secondary peak in September and a valley in October-December. Despite the geographical and social differences in Brazil, data showing the peak of conceptions in the winter and the depression in the summer suggest that birth seasonality in Brazil may have a strong component associated with climate conditions and indicate that this hypothesis along with more disaggregated data be further investigated.

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