The decline in live births and changes in fertility rates during the Zika epidemics in Brazil

Brazil was the country most affected by the ZIKV (Zika virus) epidemic starting in 2014. In the following year, the association between ZIKV and microcephaly (the most common manifestation of congenital Zika syndrome) in babies of infected mothers was established. In late 2015, the Brazilian Ministry of Health classified the increase in congenital malformations associated with ZIKV a public health emergency, while PAHO/WHO urged women to avoid pregnancy. The threat of ZIKV-related congenital syndrome could result in declining numbers of live births (and potentially fertility) via pregnancy delays and terminations, despite restrictive abortion laws. Using 2010-2016 microdata from the Brazilian Information System on Live Births, this paper examines live births and age specific fertility rates before and throughout the ZIKV epidemic in Brazil, and seeks evidence of key socio-economic differences (years of education and geographic location) in these trends. A potential limitation of our findings is that the ZIKV epidemic coincided with an ongoing economic and political crisis in Brazil that may have also influenced postponment or permanent decline in live births and fertility rates. Findings suggest a decline in live births, especially nine months after the call for pregnancy postponement. While declines in total fertility were negligible, fertility trends estimated by age and socio-economic status suggest important differences on how Zika has impacted Brazil’s fertility structure. Younger, high SES-women and women in geographic areas with higher incidence of Zika were more likely to have declining fertility rates during the period analyzed.
INTRODUCTION

In late 2015, the association between ZIKV and microcephaly (the most common manifestation of congenital Zika syndrome) was established (Brito, 2015). Shortly thereafter, the Brazilian Ministry of Health classified the increase in microcephaly and other congenital malformations associated with ZIKV a public health emergency, while PAHO/WHO urged women to avoid or postpone pregnancy (Ferguson et al., 2016). The threat of congenital malformations owing to prenatal ZIKV infection may have led some women to delay childbearing or to terminate pregnancies, despite highly restrictive abortion laws (Aiken et al., 2016). These behaviors could lead to a decline in the number of live births (or at least changes in birth growth rates), and ultimately to changes in fertility.

At the onset of the epidemic fertility levels was already below replacement in Brazil (Cavenaghi & Berquó, 2014) and more than half of births were reportedly unintended (Le et al., 2014). Importantly, there are persistent socioeconomic and geographic differences in live births and fertility trends and levels (Cavenaghi & Berquó, 2014).

The goal of this paper is therefore to investigate whether recent trends in live births and in fertility rates and age patterns have changed amidst the ZIKV epidemic in the country that was most affected by this new public health shock. Because of the longstanding socioeconomic differences in Brazil’s fertility and live birth patterns, and also because the ZIKV epidemic has disproportionately affected individuals with low-SES (Marteleto, Weitzman, Coutinho, & Valongueiro Alves, 2017), we also examine whether there are differences in live births and fertility rates by SES.

DATA AND METHODS

We use monthly data from 2010-2016 coming from administrative records on live births from Brazil’s Ministry of Health and downloaded from Sistema de Informação de Nascidos Vivos - SINASC (Ministério da Saúde, 2018). Administrative reports and vital statistics information on live births in developing countries typically face data quality issues, including delay in registration, misreporting, and undercounting (IBGE, 2015). We account for the possibility of errors and estimate a series of sensitivity analyses using datasets retrieved from Brazil’s Ministry of Health at different points in time, but we find minimal changes in findings across the versions of the data according to release date of the data.

We first examine monthly live births for the period 2010-2016 for the entire country. We then calculate yearly change in live births by month (2014 to 2015 and 2015 to 2016) during the ZIKV epidemic. Following, we estimate series of fertility rates— general fertility rates (GFR), age-specific fertility rates (ASFR) and total fertility rates (TFR)—for the entire country under multiple
scenarios. The ASFR are based on three different scenarios for the entire country and stratified by SES, which represent an exhaustive combination of three potential numerators—expected, observed, and adjusted (3%) numbers of live births—and two potential denominators—the age-specific number of females projected by two different research institutes, the Cedeplar (Cedeplar, 2014; IBGE, 2013) and the Brazilian Census Bureau (IBGE).

RESULTS

To visualize recent trends in live births in Brazil, we begin by graphing the observed monthly absolute number of live births in the period 2010-2016 (lines) and the yearly change in live births for the 2014-2015 and 2015-2016 time periods (bars) in Figure 1. While the lines from 2010-2015 portray a very similar pattern to each other, the line representing 2016 portrays a marked departure. A clear decline emerges around July and August, approximately nine months after the link between ZIKV and microcephaly was established (Brito, 2015), the Ministry of Health declared the epidemic a serious public health threat, and PAHO/WHO, as well as Brazil’s Ministry of Health encouraged women to delay pregnancy. The bars representing the annual percent change from 2014 to 2015 show a slight increase in live births in this time period. The 2015-2016 annual percentage change for each month in Figure 1 show a clear decline in live births in 2016, starting in July 2016 and accelerating in September 2016.

To test against the potential decline in the absolute number of women at childbearing ages, we estimate the expected and observed number of births using GRFs. If the GFR remained at the 2010 level until 2016, the expected number of births in Brazil would be almost 5% (4.41%) higher due to the increase in the total number of women at childbearing ages. Demographic inertia and the echoes of past higher fertility schedules should thus be contributing to increasing rather than decreasing numbers of births.

Figure 2 graphs our six different ASFRs. Panel A is based on IBGE’s age-specific projections of the female population while Panel B uses Cedeplar’s projections. Both panels portray a pattern in which the largest differences between observed and expected fertility rates occur among women of younger ages.

Figure 3 is analogous to Figure 1, but suggests clear differences in live birth trends for low- versus medium- and high-SES women. The bars corresponding to the percent change in live births from 2014 to 2015 show a decline in live births among low-SES women and slight increases among high-SES women, which is in line with evidence showing a pattern of increasing fertility among high-SES women and clear declines among low-SES women. In mid-2016, the decline trend already in course among low-SES women accelerates starting in mid-2016. For high-SES women on the other hand, the 2015 trend of modest increase in live births observed in 2015 turns
sharply into solid declines around mid-2016. This sudden and sharp change in the trend in live births suggests that high-SES women were quick in adjusting their preferences when faced with uncertainty brought by the Zika epidemic precisely nine months when the link between the virus and brain abnormalities was established.

**CONCLUSIONS AND DISCUSSION**

We find that the magnitude of the decline was larger for high-SES women, which suggests that this group of women was fast in adjusting their childbearing behaviors to the uncertainty generated by Zika, which reflects their better access to contraception and abortion or to measures of self-protection against infections.

The decline in live births was also larger and started earlier in states in the Northeast, where the Zika epidemic first started and where the microcephaly epidemic was most severe. Higher exposure to the virus might have exacerbated women’s desires and actions to prevent pregnancy (decline via pregnancy prevention) and to terminate pregnancy (decline via abortion).

Declines in ASFRs were higher for younger women with high SES levels than for any other group—low-SES women in all age groups and older high-SES women (not shown). We speculate that this group of women acted fast on their greater access to contraceptive use based on the fact that they still have a wide reproductive age window and a sense of control over their childbearing (Marteleto et al., 2017).

We thus speculate that the relatively small decline in total fertility rates we observe is likely to be short-lived and will influence the timing of childbearing mostly through a tempo effect, ultimately not affecting cohort fertility levels (quantum effect).

These findings are limited due to the fact that the ZIKV epidemic coincided with an ongoing economic and political crisis in Brazil that might hold the same effects on reproductive outcomes.
FIGURES

Figure 1. Live Births & Year % Change by Month, Brazil, 2010-2016

Figure 2. Observed and Expected Age-specific and Total Fertility Rates, Brazil, 2016
Figure 3. Live Births & Yearly % Change by Month & SES, Brazil, 2014-2016

Literature Cited


Cedeplar. (2014). *Projeção Populacional por Sexo e Grupo Etário até 2050*. Belo Horizonte: Centro de Desenvolvimento e Planejamento Regional da UFMG.


