The COVID-19 pandemic and the changes in the birth rate in the city of Fortaleza

A pandemia de COVID-19 e as mudanças na taxa de natalidade na cidade de Fortaleza

La pandemia de COVID-19 y los cambios en la tasa de natalidad en la ciudad de Fortaleza

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Abstract
COVID-19, initially identified in China, is a coronavirus causing systemic damage with a high potential for morbidity and mortality. Given the pandemic's magnitude, societal changes are suggested, as observed in other historical catastrophes, particularly impacting health and birth rates. Thus, the objective of this study was to analyze birth rates in Fortaleza during the pandemic through socio-epidemiological profiles of women and pregnant individuals. It is an observational, retrospective, descriptive, quantitative study conducted with data from 2016 to 2021 obtained from Fortaleza's SINASC. Between 2016 and 2019, a significant reduction (p<0.001) in the monthly average of live births in Fortaleza was observed compared to 2020 and 2021. Additionally, the group of neighborhoods classified with Very Low HDI was the only one that showed a significant increase in the average (p=0.02). The decrease in birth rates was consistent across all age groups, with a higher prevalence of children born to women with 8-11 years of education. Post-pandemic, there was a decline among younger women and an increase among those aged 35 to 44. Regarding prenatal visits, there was an absolute reduction, corresponding to the overall decrease in the number of births. Although many theories could explain the factors contributing to this outcome, such as increased symptoms of anxiety and depression, economic impact, and unemployment, new studies are necessary to elucidate the causes and consequences of the COVID-19 pandemic on a population's birth rate.
Keywords: COVID-19; Birth rate; Brazil; Births; HDI.

Resumo
O COVID-19, inicialmente identificado na China, é um vírus coronavírus que causa danos sistêmicos e com alto potencial de morbimortalidade. Devido à magnitude da pandemia, sugere-se mudanças na sociedade, como visto em outras catástrofes ocorridas na história, especialmente na saúde e na taxa de natalidade. Dessa maneira, o objetivo desse estudo foi realizar a análise das taxas de natalidade em Fortaleza durante a pandemia através de perfis sócio epidemiológicos de mulheres e gestantes desse período. Trata-se de um estudo observacional, retrospectivo, descritivo, quantitativo, realizado com dados de 2016 a 2021 obtidos através do SINASC de Fortaleza – CE. Entre 2016 e 2019, observamos uma redução significativa (p<0.001) na média mensal de nascidos vivos em Fortaleza, comparada a 2020 e 2021. Além disso, o grupo dos bairros enquadrados com IDH-Muito Baixo foi o único que apresentou aumento

significativo da média (p=0,02). A diminuição na taxa de natalidade foi consistente em todas as faixas, prevalecendo mais filhos entre mulheres com 8-11 anos de estudo. Após a pandemia, houve uma queda entre mulheres mais jovens e aumento entre as de 35 a 44 anos. Quanto às consultas de pré-natal, houve uma redução absoluta, que acompanha a redução no número total de nascimentos. Embora muitas teorias possam explicar os fatores que evidenciaram esse desfecho, como aumento de sintomas de ansiedade e depressivos, impacto econômico e desemprego, novos estudos são necessários para elucidar as causas e as consequências da pandemia de COVID-19 na taxa de natalidade de uma população.
Palavras-chave: COVID-19; Taxa de natalidade; Brasil; Nascimentos; IDH.

Resumen
El COVID-19, identificado inicialmente en China, es un coronavirus con alto potencial de morbimortalidad, sugiriendo cambios sociales debido a la magnitud de la pandemia, similares a otras catástrofes históricas, especialmente en salud y la tasa de natalidad. Este estudio analiza las tasas de natalidad en Fortaleza durante la pandemia mediante perfiles socioepidemiológicos de mujeres y gestantes. Es un estudio observacional, retrospectivo, descriptivo, cuantitativo, con datos de 2016 a 2021 del SINASC de Fortaleza – CE. Entre 2016 y 2019, se observó una reducción significativa (p<0.001) en la media mensual de nacidos vivos en Fortaleza, comparada con 2020 y 2021. Además, el grupo de barrios con IDH-Muy Bajo fue el único con un aumento significativo en la media (p=0,02). La disminución en la tasa de natalidad fue consistente en todas las franjas, destacándose más hijos entre mujeres con 8-11 años de estudio. Tras la pandemia, hubo una disminución en mujeres más jóvenes y un aumento entre las de 35 a 44 años. En cuanto a las consultas prenatales, hubo una reducción absoluta que coincide con la disminución total de nacimientos. Aunque diversas teorías podrían explicar los factores que evidenciaron este resultado, como el aumento de síntomas de ansiedad y depresión, impacto económico y desempleo, se necesitan nuevos estudios para dilucidar las causas y consecuencias de la pandemia de COVID-19 en la tasa de natalidad de la población.
Palabras clave: COVID-19; Tasa de natalidad; Brasil; Nacimientos; IDH.

1. Introduction

In December 2019, the first case of Coronavirus Disease 2019 (COVID-19), a respiratory and potentially systemic disease caused by the Sars-Cov-2 virus, was identified in Wuhan province, China, declared as a pandemic by the World Health Organization (WHO) about three months after the index case. In Brazil, the first case was identified on February 26, 2020, and after only two months, there were already more than 62,000 confirmed cases of COVID-19, accumulating more than 29 million cases and 660,000 deaths by March 2022 (Brazil, 2022).

In the course of the pandemic, new information regarding the transmissibility of the virus triggered the promotion of hygiene measures and social distancing worldwide to prevent large-scale infection of the population and the overloading of the healthcare system (Güner et al., 2020). Brazil has adopted the model of prevention through lockdowns in an attempt to decrease new cases of Covid-19 and prevent the collapse of the healthcare system.

This measure has proven beneficial in controlling the virus; however, it has directly impacted employment and the population's income, becoming a challenge for a more vulnerable country, with a high level of social inequality and difficult access to health care (Ministry of economy, 2020b).

Theories involving population growth and government policies show that several factors, such as economic or political, influence the birth rate of a population (Brazil, 1985). A study evaluating the fertility and birth rates in Latin American countries from 1950 to 2000 concluded that, in general, they have low birth rates during periods of economic recession, which is mainly due to unemployment. It is worth noting that the relationship between fertility rates and unemployment is not homogeneous among groups of women, being observed delayed motherhood in adverse economic periods, especially among residents of urban areas, with higher educational levels and younger (Adsera, 2011).

Furthermore, social isolation has also led to psychological changes in the population, with an increase in anxiety and depressive disorders (Torales et al. 2020b). A review study on the psychological impact of quarantine situations reported that the effects generated can be long-lasting, among them is the fear of infection or the fear of infecting others (Brooks et al., 2020). This has impacted family planning, leading couples - seeking to minimize the risks of the pandemic context, with the unstable economic, social, and/or personal outlook - to reconsider reproductive plans, since pregnancy is also a social and economic

experience, requiring a support network consisting of government and family. Studies reveal that such implications affect the desire to have a family, which decreased during the pandemic, but it is not yet possible to visualize how this might impact future birth and fertility rates (Miceli et al. 2020).

In addition, the unexpected pandemic of COVID-19, along with socioeconomic disparities, promoted changes in the functioning of Primary Health Care. One of the noticeable changes in this sphere was the modification in the demand for Primary Health Care Units (UAPS), which began to have a greater number of attendance of suspected cases of COVID-19 (Brasil, 2020). The impact of these changes generated an overload in the healthcare network, causing a decrease in resources for other sectors. It is cited, mainly, for sexual and reproductive health, which should be considered essential. The right to contraception, prenatal care, postpartum, puerperium, and sexual violence suffered interruptions and loss of quality during the crisis, causing a direct impact during this health emergency (Bilhim jav, 2021).

In such a way, it is elucidated that the changes in the panorama affected the female user population of the Unified Health System (SUS), especially layers of vulnerabilities. A study in the city of Fortaleza, Ceará, Brazil, reveals the above. In the city, the mortality rate by COVID-19 reached 7.6 per 10,000 inhabitants; however, what was most striking in the results presented was the disparity in the distribution of deaths in the city neighborhoods, revealing a disproportionate impact, affecting especially the poorest layers, especially households run by low-income women who have informal jobs with high exposure to the virus (Carlos et al. 2021).

It was already hypothesized that the existence of a pandemic, causing a high rate of morbidity, mortality, and socioeconomic changes, would result in changes in the birth profile of a given population (Boberg-Fazlic et al., 2017). Studies that have evaluated the impact of epidemics with high fatality rates have shown a significant decline in the birth rate in the months following the events. For example, the fertility rate, which is directly linked to the birth rate, was at its lowest level in the year 1919, during the Spanish flu pandemic, when compared to the period 1913 to 1918, in which there were no significant changes (ULLAH, 2020). More recently, this same trend was evidenced in Brazil, when there were fewer births than expected from September 2015 to December 2016, right after the emergence of the Zika virus epidemic (Castro et al., 2018). It is important to report that studies show that after several months (8-12 months) of these epidemics, there was a recovery or overcoming of the birth rate, a phenomenon known as the "baby boom" (ULLAH, 2020).

Given the above, because of the prevalence of cases and the social and economic impacts of the crisis of COVID-19 in the current global and local context, an analysis of how the pandemic may be influencing birth rates is necessary. It becomes necessary to evidence socio-epidemiological profiles of women and pregnant women in this period, detecting social and individual vulnerabilities that may have impacted the change in these patterns.

Thus, the objective of this study was to analyze birth rates in Fortaleza during the pandemic through socio-epidemiological profiles of women and pregnant individuals.

2. Methodology

This is an observational, retrospective, descriptive, quantitative study, carried out with data obtained from the Live Births Information System (SINASC) of Fortaleza - CE (Pereira, 2018). This system is managed by the Health Surveillance Secretariat (SVS/MS) of the Ministry of Health, and its database is fed by the city of Fortaleza, containing the main information about live births.

2.1 Data Collection

Data was collected from SINASC Fortaleza from 2016 to 2021. The categories used were: total live births, number of live births per neighborhood, number of prenatal consultations, number of weeks of gestation, level of education, and age of the

mothers. All data were selected from the municipality of occurrence, Fortaleza - CE. Then, they were stored in a database through Microsoft Excel software and, later, were submitted for statistical analysis.

The HDI rates of all the city neighborhoods, dated 2010, the year of the last national demographic census, were also collected and available on the city government's website. These rates were added to the aforementioned database.

2.2 Statistical Analysis

R version 4.2.0 software was used. The data were submitted to the Kolmogorov-Smirnov normality test.

We performed a descriptive analysis of the level of education, age of the mothers, number of weeks of gestation, and number of prenatal visits, all concerning the number of births in the periods before and during the pandemic, which were presented in absolute and relative frequency.

The monthly average of live births was calculated for the period between 2016 and 2019 for comparison with the period between 2020 and 2021. To analyze the socioeconomic component of the changes in the birth rate in this period, we separated the neighborhoods into 5 groups according to the HDI range (source from the city government). Thus, 27 neighborhoods with HDI value <0.25 were grouped as very low HDI (HDI-MB), 34 with values from 0.25 to <0.35 as low HDI (HDI-BB), 28 with values up to <0.5 as medium HDI (HDI-MM), 20 with values up to <0.7 as high HDI (HDI-HA), and finally 8 neighborhoods with values ≥0.7 as very high HDI (HDI-MA). The values were submitted to the Kolmogorov-Smirnov normality test and compared using Student's t-test (parametric data). A significance level (α) of 5% ($p < 0.05$) was considered.

3. Results

Graph 1 - Average monthly live births in the compared periods.
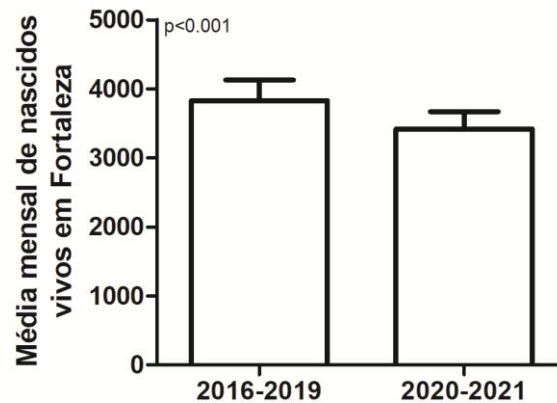
Source: Authors (2024).

The figure above illustrates the monthly average of live births in Fortaleza from 2016 to 2019 compared to 2020-2021. The period of 2016-2019 stands out for having a higher average than the period of 2020-2021.

There was also a significant reduction in the average monthly live births in Fortaleza from the period between 2016 and 2019 compared to 2020 and 2021 from 3851±277 (3348 - 4455) live births per month to 3422±248 (3002 - 3867) ($p<0.001$, Student's t-test), an average reduction of 429±67 live births per month.

Table 1 - Changes in average births by HDI range.

HDI Index	Average Births in the Pre-Pandemic Period	Average Births in the Pandemic Period	Average difference	p-value
Very Low HDI (HDI-MB)	315	419	+104	0,02
Low HDI (HDI-BB)	246	220	-26	0,2
Average HDI (HDI-MM)	230	213	-17	0,5
High HDI (HDI-HA)	124	121	-3	0,87
Very high HDI (HDI-MA)	185	179	-6	0,90

Source: Authors (2024).

The table above presents the birth rate averages in pre-pandemic and pandemic periods, compared to the analyzed Human Development Index (HDI) profiles. It highlights the largest difference in the birth rate average during the pandemic period for the Very Low HDI group.

When analyzing the number of live births by HDI range, most of the groups analyzed showed a decrease in the absolute number of births, and no significant difference was found in the mean number of live births when compared to data from the pre-pandemic years (2016-2019) as seen in table 1. The IDH-MB group was the only one that showed a significant increase in the mean (p=0.02), being 419±285 during the pandemic years and previously 315±258 (difference of 104±44).

**Graph 2 -** natality and schooling over time.
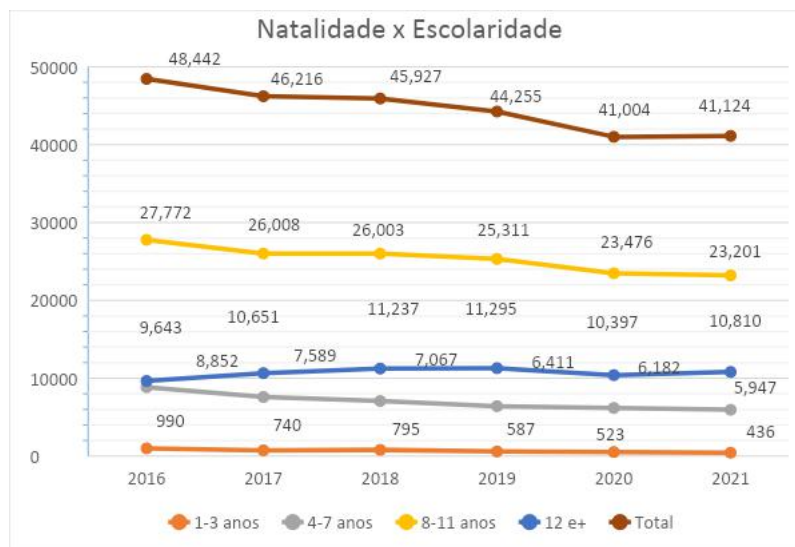
Source: Authors (2024).

The previous figure displays the birth rates in comparison with the level of education during the studied period, indicating a higher birth rate throughout the studied period for the group of women with 8-11 years of education.

Concerning the data that correlate births in the pandemic period with the level of education of the women, we note that the pattern of decrease in the birth rate follows equally in all ranges independent of the years of study. In general, during all years, before and during the pandemic, women with 8 to 11 years of education are the ones who have the most children,

corresponding to about 55% (+/- 2%).

**Graph 3 -** percentage of births by maternal age group.
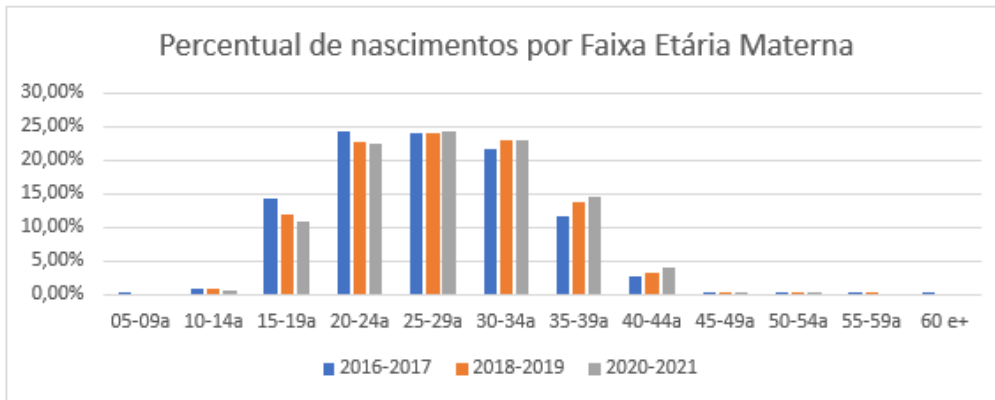
Source: Authors (2024).

The figure above illustrates the percentage of births by maternal age group during the study period. There is a higher prevalence observed among the age groups of 20 to 34 years.

When comparing the percentage of births by maternal age group in the years 2016-2021, we observed that after the pandemic we maintained a pattern of decreasing births among younger women and an increase among women aged 35 to 44.

Graph 4 - Inefficient and efficient prenatal visits pre and post-pandemic.
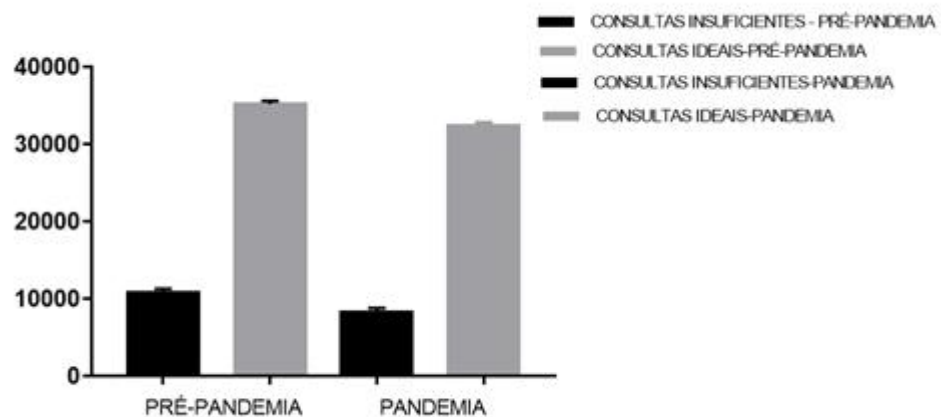
Source: Authors (2024).

The figure above presents the comparison between an adequate and inadequate number of prenatal visits during the study period. It is possible to observe a reduction in the number of sufficient prenatal visits during the pandemic period.

Regarding the analysis of the number of insufficient prenatal consultations (less than 6) before and during the pandemic, it is observed that there was an absolute reduction, but that this decrease follows the reduction in the total number of births, as expected with the reduction in birth rates already evidenced. As for the relative observation, the proportion of prenatal consultations with an insufficient number of consultations on the total number of follow-ups was reduced, but still following the trend of previous years (20.3% in 2016; 18% in 2017; 17.2% in 2018; 16.5% in 2019; 17.5% in 2020, and 14.7% in 2021).

4. Discussion

Our research showed a significant reduction in the mean number of live births during the pandemic period from 3851 ± 277 live births per month to 3422 ± 248 ($p<0.001$), a mean reduction of 429 ± 67 live births per month. This change can be explained by the difficulty of access to the basic health unit during the pandemic, consequently hindering access to contraceptive methods and health education, whose role is important in family planning. Other possible justifications can be given by research that addressed the impact of covid-19 on sexual health and shows that there was a decrease in the frequency of sexual intercourse (SI) during the pandemic. It is worth noting that sexual activity among young people also decreased during the period, which was shown in a survey conducted in China during the said period with people aged 15-35 years (LI, 2020). An Italian study points to a lack of privacy, lack of psychological stimulation, and the number of children as contributing factors to this reduction (Cito, 2021).

In addition, relationship satisfaction and well-being can result in an increased frequency of sexual intercourse (Muise, 20215). An online study including participants from 63 countries, primarily from the United States and Europe showed that during the pandemic couples who did not live together or who were subjected to strict restraints experienced decreased relationship satisfaction, which was not evidenced for those who lived together or spent more time with their partners (Vigl, 2021). These changes related to the lockdown period may have negatively impacted the desire to child bear among younger women and thus impacted a lower birth rate among this group after the peak of the pandemic, as was evidenced in a 2020 study from Colombia (Mendonza, 2020).

The medical model of disease tended to ignore socioeconomic factors during the pandemic crisis, allowing the pandemic to disempower populations and highlight social inequalities around the world. An estimated 20 million people have returned to extreme poverty, and about 37 million will return in the next 2 years, affecting especially the continents of Latin America and Africa. These regions are already marked by a strong index of social inequality and poverty, which culminated in worsening mortality and lethality rates by COVID-19, some factors that culminated in such outcomes are cited, such as the propensity to live in overcrowded homes in which they have inadequate access to drinking water and sewage treatment, employment positions that do not allow work at home, difficult access to basic health services and reaching tertiary services in later stages of the disease. A study of women of different ethnicities living in the United States showed that women who were unable to afford food, transportation, and/or housing were twice as likely to report a drop in their desire to become pregnant during the pandemic compared to those who reported being able to afford necessities (LIN, 2021). However, it is worth noting that in countries with high HDI, such as the US, there is generally more family planning, while in Brazil, developed programs do not yet support this need. Therefore, although the desire to become pregnant may have decreased during the pandemic due to economic changes, different localities and realities do not react in the same way.

In Brazil, a recent study revealed that in the most unequal states, the lethality and morbidity rates for the disease were higher, adding that the risk of an individual dying in these regions increases about 10 times more (Demenech et al. 2020). Another study in the city of Fortaleza (Sanhueza-Sanzana et al. 2021) showed a disparity in deaths from the disease, which mainly affected poorer populations. Thus, although there are still not enough literature holdings that portray how COVID-19 affected other epidemiological metrics, such as birth rate, we can see how the various publications related to our research, since we visualized a significant increase ($p=0.02$) in the number of live births in the lowest HDI range, of the HDI-MB group, being 419.18 during the pandemic years and previously 315.01 (difference of 104.17). It can be speculated that this result indicates a lower condition of access to available contraceptive methods or even to health education through primary care - which can provide adequate family planning - during the period of a health crisis, in which many services were suspended, as mentioned above.

During the pandemic, none of the reporting systems correlated COVID-19 mortality with schooling data, in this study we tried to correlate changes in birth rates and schooling in women who became pregnant during the period 2019-2021, but we

found no significant value. In the descriptive analysis performed, we observed that the degree of schooling follows the total reduction in live births without proportional distinction. It is known that the birth rate is related to the schooling rate. Brazil has an average age of first pregnancy between 15 and 29 years old and is among the 10 countries with the highest prevalence of teenage pregnancy in the world (Fernandes, 2019). Current Brazilian studies already show that women who become pregnant at younger ages present lower degrees of schooling, a study conducted in the state of São Paulo in 1997 (Fujimori et al. 1997) revealed that of 155 pregnant women interviewed 85% had abandoned formal education and 79.4 did not complete 8 years of study, such a pattern has not been changed until the current moment. Several factors justify this interruption in schooling, such as economic limitations that cause these girls to look for informal jobs and social limitations that still place the role of the woman as the caretaker of the home and the educator of the children.

Although no relationship was found between the increase in pregnancies during the pandemic period and the level of education at the time, an increase in the birth rate may occur in the coming years. Similar to what happened after World War II, the pandemic period of COVID-19, according to some researchers, may stimulate a new "Baby Boom". People who have delayed their plans to become pregnant, due to unemployment and economic crisis, or to psychosocial factors that the coronavirus brought, may be stimulated by the improved outlook. Therefore, in the following years, we will be able to analyze how schooling may interfere with the birth rate in this period.

As for the number of prenatal visits, likely, the pandemic did not have a strong influence on the pre-existing facilities or difficulties in Fortaleza, since the ratio between insufficient and sufficient follow-up visits remained similar to previous years.

Another important point to be evaluated in future studies concerns the social changes that covid 19 generated and that directly impacted the mental health of the population. The high prevalence in the number of anxiety, depression, and sadness symptoms was documented by a Brazilian study that encompassed all macro-regions of the country (Barros, 2020). It is known that higher levels of sexual satisfaction are related to lower rates of anxiety in adolescents and depression in adults (Carcedo, 2020). Studies also show that a decrease in well-being is significantly related to a decrease in the number of sexual intercourses (Cito, 2021). Thus, the increase in the rate of mental disorders may have been one of the factors contributing to the decrease in the birth rate. These factors also impact the birth rate and are worth further evaluation.

Some difficulties were encountered during the research. First, due to being sectional research, it is difficult to diagnose the cause and effect of COVID-19 concerning changes in the birth rate. The absence of individual medical records also made it impossible to correlate demographic data and changes in the birth rate. In addition, the pandemic period analyzed (2020-2021) comprises births from pregnancies that were already ongoing before the pandemic began, potentially underestimating our results. The short pandemic period for analysis also does not allow for large statistical analyses at the local level. An alternative would be to subdivide into months, but the amount of births per month is variable, thus making it unfeasible to compare different months. Nevertheless, our division between pandemic months from 2020 to 2021 and pre-pandemic months from 2016-2019 allowed us to achieve relevant results. The pre-pandemic period of only 4 years aimed to reduce changes related to the age pyramid currently underway in Brazil. Another important aspect was the difficulty in finding recent data in the literature compatible with our investigation.

5. Conclusion

There was a significant reduction in the monthly average of live births in Fortaleza during the pandemic period from 3851 ± 277 (3348 - 4455) born per month to 3422 ± 248 (3002 - 3867) ($p<0.001$, Student's t test), a mean reduction of 429 ± 67 live births per month. On the other hand, the neighborhoods in the very low HDI group showed a significant increase in the average number of live births ($p=0.02$), being 419.18 during the pandemic years and, previously, 315.01 (difference of 104.17).

Moreover, it is important for new studies to be conducted to identify possible causes of the overall decrease in live

births during the pandemic period and the specific increase in births in the Very Low HDI group.

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