Área 13 – Desigualdade, pobreza e políticas sociais

Does extending school time reduce the juvenile pregnancy rate? A longitudinal analysis of Ceará State (Brazil)

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Abstract: Adolescent pregnancy is a social problem that induces young people to drop out of school early. On the other hand, the effects of an expansion of high school education can provide a reduction in adolescent pregnancy rates since educational level is the most important risk factor for sexual initiation, the use of contraceptive methods in the first sexual encounter, and fertility. The aim of this paper is to analyze the impact of the implementation of the public educational policy of full-time schools (FTS) for high school in Ceará state, Brazil, on the rate of early pregnancy. Using the difference-in-differences method with multiple time periods, we measured the average effect of this staggered treatment on the treated municipalities. The main result indicates a 0.849 percentage point reduction in the teenage pregnancy rate. That implies a reduction of 3.5% over the average juvenile pregnancy rate in Ceará (21.6%). We considered heterogeneous effects within socioeconomically vulnerable municipalities. However, there is no difference in the impact of this group. Robustness tests show that the results are robust.

Keywords: Teenage pregnancy, Full-time school, Difference-in-Differences

JEL: I28, I18, J13, H51

Resumo: A gravidez na adolescência é um problema social que induz jovens a abandonarem precocemente a escola. Por outro lado, os efeitos da expansão do Ensino Médio podem proporcionar redução nas taxas de gravidez na adolescência, uma vez que a escolaridade é o fator de risco mais importante para a iniciação sexual, o uso de métodos contraceptivos na primeira relação sexual e a fertilidade. O objetivo deste trabalho é analisar o impacto da implementação da política educacional pública de escolas de tempo integral (ETI) para o Ensino Médio no estado do Ceará, Brasil, sobre a taxa de gravidez precoce. Usando o método de diferenças em diferenças com vários períodos de tempo, medimos o efeito médio desse tratamento escalonado nos municípios tratados. O principal resultado indica uma redução de 0,849 ponto percentual na taxa de gravidez na adolescência. Isso implica uma redução de 3,5% sobre a taxa média de gravidez juvenil no Ceará (21,6%). Consideramos efeitos heterogêneos dentro de municípios socioeconomicamente vulneráveis. No entanto, não há diferença no impacto desse grupo. Os testes de robustez mostram que os resultados são robustos.

Palavras-chaves: Gravidez na adolescência, Escola de tempo integral, Diferenças em diferenças

JEL: I28, I18, J13, H51

1 Introduction

The phenomenon of teenage pregnancy is a serious issue that affects developing countries most deeply. Latin America and the Caribbean's fertility levels in adolescence (15 to 19 years old) are 61 births per thousand teenagers and are very high compared to the world average (41 births per thousand women aged 15 to 19 years old) (Baker et al., 2022)**.** In Brazil, the average fertility rate between 2004 and 2020 was 49 births per thousand adolescents. The 2019 National Survey of School Health (PeNSE) of the Brazilian Institute of Geography and Statistics (IBGE)[1] points out that 35.4% of adolescents aged 13 to 17 had a sexual relationship at least once, and 7.9% of girls got pregnant. If these adolescents are in public schools, the pregnancy rate rises to 8.4%. The 2019 PeNSE also shows that juvenile pregnancy is more frequent in the northeast region of Brazil. The adolescent pregnancy rate reaches 10.9% in the northeast.

According to data from the Ministry of Health, the average rate of early pregnancy between 2000 and 2018 was 20.4% and 21.6% in Brazil and Ceará, respectively. This means that, among all births and fetal deaths, 20.4% of them had adolescents between 15 and 19 years old as mothers in the country.

Some risky factors that contribute to the rise of this social problem are lower education, misinformation about sexual prevention, and a lack of parental guidance (Ahinkorah et al., 2021; Cruz et al., 2016; Jochim et al., 2021; Kassa et al., 2018; Thobejane, 2015). In Latin America and the Caribbean, public policies related to conditional cash transfers and compulsory education are correlated with the prevention of adolescent pregnancy (Ribas, 2021). In the United States, making it mandatory for teenagers to stay in school until the age of 16 reduces the probability of a pregnancy before the age of 20 by 4.7% (Black et al., 2008).

Although full-time schooling (FTS) is a public policy that helps in the personal and professional development of high school students (Mariano & Arraes, 2018; Pires & Urzua, 2010), the literature on the effects of school day length on several outcomes, such as academic performance, crime, and early pregnancy, is not yet consolidated (Mariano & Arraes, 2018; Pires & Urzua, 2010). Some studies show positive effects **(Figlio et al., 2018; Long, 2014; Sánchez & Favara, 2019; Wu, 2020)**, while others show ambiguous or non-existent effects **(Battistin & Meroni, 2016; Folsom et al., 2016; Jensen, 2013)**.

The relationship between education and early pregnancy adds a tricky aspect due to the endogeneity between variables. On the one hand, studies point out that the effects of an expansion of secondary education can lead to a reduction in teenage pregnancy rates **(Berthelon & Kruger, 2011; Black et al., 2008; Leite et al., 2004; F. M. Santos & Pazello, 2012)**. In Chile, a 20% increase in full-time school enrollment reduces the likelihood of early pregnancy by 5% **(Kruger & Berthelon, 2009)**. These findings are corroborated by other studies **(Berthelon & Kruger, 2011; Pires & Urzua, 2010)**. In addition, the temporary closure of high schools, triggered by a student strike in 2011, increased teenage pregnancies by 1.5% on average (Celhay et al., 2022).

In Peru, a school day extension program called Jornada Escolar Completa (JEC) had an impact on preventing early pregnancy through channels such as increasing young people's educational aspirations and psychosocial skills **(Sánchez & Favara, 2019)**. In Africa, where the prevalence of teenage pregnancy can reach 44.3% (Congo), the chances of early motherhood increase if the teenager has only primary education (Ahinkorah et al., 2021). Among the factors associated with teenage pregnancy on the continent are living in a rural area, not attending school, and not having parents with formal education (Kassa et al., 2018).

[1] Available in: https://educa.ibge.gov.br/jovens/materias-especiais/21457-a-saude-dos-adolescentes.html

In Brazil, there is evidence that the expansion of access to secondary school between 1997 and 2009 led to reduced adolescent fertility. Increasing the number of schools per 100 women reduces female fertility by 0.25 to 0.563 births per 100 **(Koppensteiner & Matheson, 2021)**. Education and income have been shown to be important indicators of variation in the level of pregnant adolescents among the municipalities of the Legal Amazon (T. C. M. dos Santos et al., 2021). The socioeconomic profile shows that women between 10 and 19 years old who have higher education are less likely to get pregnant (Cruz et al., 2016).

On the other hand, if the expansion of access to school and the school day have an impact on early pregnancy, motherhood in adolescence itself leads to consequences that can jeopardize school performance, academic training, and the future income stream of young people since it induces school dropout **(Cerqueira-Santos et al., 2010; Jochim et al., 2021; Masterson et al., 2021; F. M. Santos & Pazello, 2012)**.

Early and unplanned pregnancy leads to school dropout in South Africa due to a lack of parental guidance and information on the subject (Jochim et al., 2021; Masuku, 2021; Thobejane, 2015). In the state of Arkansas (USA), teenage motherhood explains 31.4% of the variation in school dropout (Masterson et al., 2021).

In Brazil, the risk of an adolescent with five or more years of education having a child is 58% lower than that of those with less education (Leite et al., 2004). In addition, a reduction of 19.4 percentage points is estimated in the probability of a pregnant teenager attending school, and early pregnancy reduces the probability of completing elementary school by 13 percentage points **(F. M. Santos & Pazello, 2012)**.

In the cities of Salvador, Rio de Janeiro, and Porto Alegre, a cross-sectional study involving 4,634 young people between 18 and 24 years old points out that the main reason for young women to interrupt their studies is due to pregnancy and the birth of children (Almeida, 2008). Additionally, the lack of prevention programs and the sexual orientation and reception of teenage mothers in school contribute to dropout rates (Avila, 2015).

In the Northeast region of Brazil, where fertility rates in adolescence are higher, early pregnancy leads to greater interruptions in school life. Furthermore, low education, a lack of professional experience, and the need to take care of children are obstacles in the search for a job for these young people (J. S. Costa et al., 2021; Pereira, 2014; Sousa et al., 2018).

The goal of this article is to isolate and measure the impact that the implementation of full-time schooling has on the teenage pregnancy rate in the municipalities of Ceará. In order to investigate the causal relationship between the educational public policy of full-time schools and the early pregnancy rate in the municipalities of Ceará, the staggered implementation of the full-time program in different periods and municipalities was taken into account for the period from 2000 to 2018.

The difference-in-differences method (DIF-IN-DIF) with multiple time periods was used to capture the average effect of treatment on the early pregnancy rate in treated municipalities. We cross the databases linked to the Ministry of Health (DATASUS), the National Institute of Educational Studies and Research Anísio Teixeira (INEP), the Institute of Applied Economic Research (IPEA), the Brazilian Institute of Geography and Statistics (IBGE), the Federation of Industries of Rio de Janeiro (Firjan), and the Secretariat of Basic Education of the State of Ceará (SEDUC).

Due to the lack of data on the exact year of implementation of the full-time school program in all Brazilian municipalities, the research is limited to municipalities in Ceará. However, Ceará has stand out in the implementation of educational policies that have become an example at the national level and have been expanded. Among these policies, there is the Full-Time School (FTS) Program. In addition to the average effect of the treatment (ATE) on the treated, the work shows an analysis of the dynamic effect for the time of exposure to the treatment. This paper aims to contribute to: i) a consolidation of research on the subject; ii) the

forwarding and analysis of public policy based on evidence; and iii) a deepening of the evaluation for subgroups of the sample (heterogeneous effect).

In addition to this introduction, this study shows how the implementation of the educational public policy for full-time schools in Ceará was carried out. In the third section, the methodology is presented. Section four shows the results, and Section five performs model robustness tests. The sixth section analyzes possible heterogeneous effects. Finally, the seventh section presents the final considerations.

2 Context

Ceará is a state in northeastern Brazil, and it is one of the poorest regions in the country. The territorial dimension of Ceará is approximately 149 thousand square kilometers, equivalent to Greece, and the population was around nine million in 2022, according to the IBGE. According to the Brazilian Institute of Economics (IBRE-FGV), Ceará's GDP per capita in 2019 was $5,635 USD, or 49% of Brazil's GDP per capita ($11,500 USD). The Human Development Index (HDI) is 0.68, which is considered medium development.

The state of Ceará has stood out in the implementation of educational policies that have become an example at the national level and have been expanded, such as the Literacy Program at the Right Age (PAIC) and tax transfer incentives for municipalities that obtain indexes with better educational quality. In addition to these policies, there is the Full-Time Schools (FTS) program.

There are two FTS models: the State Schools of Vocational Education (SSVE), which began the implementation process in 2008, and the Full-Time High Schools (FTHS), whose implementation began in 2016. The SSVE is designed to help young people enter the labor force. In 2008, the first 25 schools that met four criteria were installed: 1. be in a municipality where a Regional Education Development Coordination (CREDE) is located; 2. be located in areas of social vulnerability; 3. present educational indicators lower than expected, inducing its revitalization; and 4. have the minimum infrastructure necessary for deployment.

These schools (SSVE) received funding from the federal government through the *Programa Brasil Profissionalizado*. In 2019, there were 122 school units in 95 municipalities and 55,000 students enrolled, representing about 20% of the total number of students in secondary state public education. The school provides for the teaching of technical courses in various areas of activity during the after-shift, adding up to 52 courses in total[2]. The content of the professional curriculum is less flexible, and the student continues through the three years of high school in the same course[3]. It is worth mentioning that not all full-time schools in the state have programs aimed at training the labor market, but they have similar workloads in the classroom.

The FTHS were implemented in 2016. The difference between these two types of full-time education is mainly conditioned by: i) the student selection and admission process, in which the SSVE observes performance in lower secondary school, which does not occur in FTHS; ii) the presence of an after-shift course at the SSVE aimed specifically at professional training and student preparation for the labor market. FTHS has a more flexible and comprehensive curriculum, aimed at reinforcing the cognitive performance of the main subjects of the Common Curriculum Base in the after-school period but also employing a holistic view with subjects aimed at obtaining socio-emotional skills.

[2] Available at: https://educacaoprofissional.seduc.ce.gov.br/index.php?option=com_content&view=article&id=3&Itemid=103

[3] When there were vacancies in some courses, eventually the school allowed the exchange of courses.

The FTHS implementation process began in 2015, when the Ceará state government[4] established criteria for school eligibility to participate in the program: 1. be located in a populous municipality; 2. have 50% of students in socioeconomic vulnerability; 3. have at least 60% of vacancies occupied for the feasibility of implementing the school; 4. there should be at least one part-time secondary school in the municipality where it is located, which would allow students to choose the type of school.

Although it is a public policy designed to increase the academic performance of high school students with an impact on standardized tests in mathematics and reading (Mariano & Arraes, 2018), FTS can generate spillovers on other social outcomes in addition to educational ones.

3 Methodology

3.1 Databases

For this research, information was extracted from different databases for the 184 municipalities of the state of Ceará: 1. DATASUS (Department of Informatics of the Health System of Brazil); 2. INEP (National Institute of Educational Studies and Research Anisio Teixeira); 3. IBGE (Brazilian Institute of Geography and Statistics); 4. IPEA (Research and Applied Economics Institute); 5. FIRJAN (Federation of Industries of Rio de Janeiro).

Table 1 shows the description of the variables used in the econometric models. With data from 2000 to 2018 obtained from DATASUS, the outcome variable indicates the youth pregnancy rate in percentage terms as defined by the Ministry of Health. The variable is measured as follows:

$$P_{it}^{15-19} = \frac{B_{it}^{15-19} + F_{it}^{15-19}}{B_{it} + F_{it}} x100 \quad (1)$$

P_{it} is the youth pregnancy rate in municipality *i* during period *t*. B_{it}^{15-19} is the number of live births in adolescence. F_{it}^{15-19} is the number of fetal deaths for mothers in this age group. B_{it} is the total number of live births in municipality *i* during period *t*. F_{it} is the total number of fetal deaths.

Table 1. Description of the model variables

VARIABLE	DESCRIPTION	DATABASE
Dependent variable		
Youth pregnancy rate (%)	(Live births in adolescence + fetal deaths in adolescence) / (Total live births + total fetal deaths)	DATASUS
Treatment variables		
Treatment	Year of implementation of the first FTS in a municipality	SEDUC
Full-time enrollment in school (%)	Number of female adolescents enrolled in full-time schools in relation to the number of female adolescents in public schools	INEP

[4] Available at: https://www.seduc.ce.gov.br/escolas-de-ensino-medio-em-tempo-integral-eemti/

Treat	Binary variable that indicates 1 if the municipality was treated and 0 otherwise	SEDUC
Predetermined variables		
GDPpc	GDP per capita at constant 2010 values	IBGE
IVS	Social Vulnerability Index	IPEA
IFDM	FIRJAN Municipal Development Index	FIRJAN
Approval (%)	Percentage of high school students that are approved in the municipality	INEP
Dropout (%)	Percentage of high school students that drop out of school in the municipality	INEP
CREDE	Binary variable that indicates 1 if the municipality is the seat of regional education development coordination (crede) and 0 otherwise	SEDUC

Source: personal creation

The treatment variable of the main model is defined at the municipal level as the year in which the first Full-Time School (FTS) is installed in the municipality. This administrative data was provided by the Secretariat of Basic Education of the State of Ceará, which ended up spatially delimiting this study.

The model that tests the robustness of the results used the percentage of full-time students as a treatment variable. That variable corresponds to the number of female adolescents enrolled in full-time schools in relation to the number of female adolescents in public schools during the period 2000–2018.

The variable *treat* corresponds to a binary indicator (0 or 1). The value 1 indicates the existence of a FTS in that municipality, while the value 0 indicates that the municipality had no Full-Time School during the period 2000–2018.

Finally, before the treatment begins, the predetermined variables control the level of economic development in each municipality. All predetermined variable values need to be measured before starting treatment (2008) so that municipalities can be paired and compared with the control group. The insertion of these variables in the model aims to capture the effects of the criteria for choosing the municipalities for the implementation of the educational public policy.

The GDP per capita at constant prices for 2010 included the period from 2000 to 2007. The Firjan Human Development Index (IFDH) measures the socioeconomic development of the municipalities from 2005 to 2007. The index varies from 0 to 1 and includes areas such as employment and income, education, and health. The Index is closest to one when the municipality is more developed.

It is important to control the model for educational variables that functioned as criteria to choose the municipality as treated. So we control the quality of the school, including the approval rate and dropout rate. The crede variable indicates the criteria used to choose the municipalities that are seats of CREDE. Beyond those control variables, we used the 2000 Social Vulnerability Index (IVS) to consider heterogeneous effects and compose subsamples. The IVS is a complementary index to the Human Development Index (HDI) and has 16

indicators linked to three dimensions: urban infrastructure, human capital, and labor and income. The Index ranges from 0 to 1, and the closer it is to 1, the greater the social vulnerability of the municipality (M. A. Costa & Marguti, 2015).

3.2 Difference-in-differences method

The canonical difference-in-differences (DiD) method shows two time periods and two groups: no one is treated in the first period, and in the second period, some units are treated (treatment group). One can estimate the average treatment effect (ATE) on the treated by comparing the average change in outcomes. The method is inadequate for the staggered treatment of the treated municipalities ***(Athey & Imbens, 2006; Callaway & Sant'Anna, 2021; Rosa, Bruce, et al., 2022)***.

We used the difference-in-differences (DiD) method with multiple time periods to analyze the average treatment effect on the treated. Under certain assumptions related to treatment anticipation behavior and conditional parallel trends, the ATE estimates the causal effect of educational public policy on the adolescent pregnancy rate in the municipalities of Ceará. Under these assumptions, the group-time ATE is non-parametrically identified ***(Callaway & Sant'Anna, 2021)***.

There are three sufficient conditions related to treatment anticipation behavior and conditional parallel trends in which group-time average treatment effects are non-parametrically identified: 1. treatment irreversibility; 2. random sampling; and 3. limited treatment anticipation ***(Callaway & Sant'Anna, 2021; Rosa, Bruce, et al., 2022)***.

The first condition of treatment irreversibility indicates that the treated unit remains treated in the following periods. That is, once a FTS is installed in the municipality, it will always be a full-time school in the municipality, and this unit cannot be reverted to any other teaching modality. The administrative data provided by SEDUC shows that there was no reversal in the treatment for any of the municipalities treated.

The second condition implies an independent and identically distributed sample (IID). As suggested by Callaway and Santanna (2021), we can address assumption 2 by using panel data. This assumption allows us to see potential outcomes as random. Furthermore, it does not impose restrictions between potential outcomes and treatment allocation, nor does it restrict the time series dependence of the observed random variables.

Finally, the third hypothesis of the identification problem consists of the limitation of treatment anticipation. The assumption is addressed by the fact that local government had no control over the treatment status of the municipality. Secondary schools are under the jurisdiction of the state government.

Two control groups were used in the research. First, we compare the treated group of municipalities at time *g* with a group of municipalities that have not adopted the program yet (*not-yet*). We estimate a distinct difference-in-differences for each year *t*, implying that the control group changes over time. Second, we compare the treated group of municipalities with the group that never adopted the program (*never treated*). This control group represents 48.9% of the municipalities in Ceará (90 municipalities).

3.3. Average treatment effects on treated

When the first full-time high school (FTS) is implemented in year *g*, a municipality *i* is considered treated. In the *t* periods prior to the implementation of the school, this municipality was considered untreated $(\boldsymbol{D_i = 0})\forall \boldsymbol{t < g}$. According to the irreversibility of the treatment assumption, $(\boldsymbol{D_i = 1})\forall \boldsymbol{t \geq g}$.

The average treatment effect (ATE) on treated is the difference between the potential outcomes of the adolescent pregnancy rate of treated ($\boldsymbol{Y_t(1)}$) and untreated ($\boldsymbol{Y_t(0)}$), on average, for the units of the treated group ($\boldsymbol{D_i = 1}$). I.e.:

$$ATE(g,t) = E[Y_t(g) - Y_t(0)|G_g = 1] \quad (2)$$

As, for each period *t*, we can observe only one potential outcome, it is necessary to establish a comparision with a group of municipalities that have not yet implemented FTS $(D_i = 0)\forall t$.

$$ATE(g,t) = E\left[Y_t - Y_{g-1}\middle|X, G = g\right] - E[Y_t - Y_{g-1}|X, D_t = 0, G \neq g] \quad (3)$$

In this case, for the causal interpretation of the results, the following hypothesis of a parallel trend was used:

$$E[Y_t(0) - Y_{t-1}(0)|X, G = g] = E[Y_t(0) - Y_{t-1}(0)|X, D_s = 0, G \neq g] \quad (4)$$

For comparison, we used never-treated municipalities as the control group.

$$ATE(g,t) = E\left[Y_t - Y_{g-1}\middle|X, G = g\right] - E[Y_t - Y_{g-1}|X, C = 1] \quad (5)$$

Using *never-treated* municipalities as a control, the following parallel hypothesis is used:

$$E[Y_t(0) - Y_{t-1}(0)|X, G = g] = E[Y_t(0) - Y_{t-1}(0)|X, C = 1] \quad (6)$$

The aggregate parameter of interest measures the average effect of treatment on treated considering the total average of all groups and treatment periods as follows:

$$\theta_S^O = \frac{1}{k}\sum_{g\epsilon G}\sum_{t=2}^{T} 1\{g \leq t\}ATT(g,t)P(G = g|G \leq T) \quad (7)$$

Additionally, the dymanic effects of treatment exposure will also be graphically presented for *e* periods, as follows:

$$\theta_D(e) = \sum_{g=2}^{T} 1\{g + e \leq T\}ATT(g, g+e)P(G = g|G + e \leq T) \quad (8)$$

4 Results

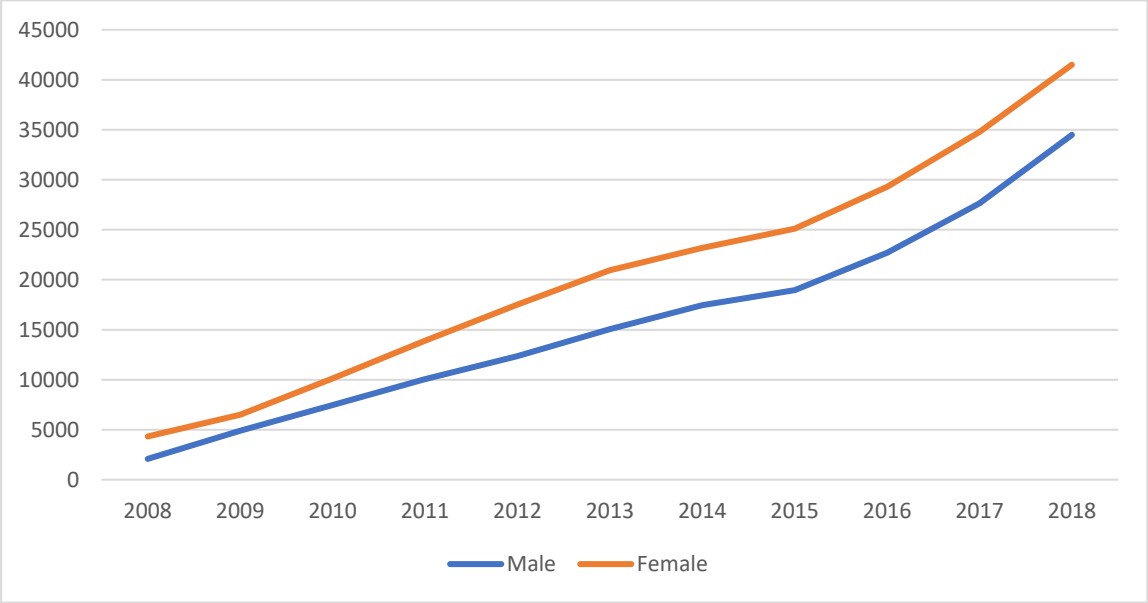
4.1 Descriptive results

The educational public policy under analysis shows some positive impacts on academic performance, although these results are not yet consolidated (Estrada et al., 2022; Rosa, Bettinger, et al., 2022). The spillovers from full-time school are much less investigated, and, therefore, FTS may have an impact on a student's life in ways other than cognitive. Non-cognitive issues involving social relationships (crime, early pregnancy) and socioemotional aspects must be taken into account.

Figure 1 presents a longitudinal series of the enrollment of full-time high school students from 2008 to 2018 by sex. We observe that there is a greater adherence among young females

to full-time education. We can also note an inflection in the enrollment curve from 2015 onwards.

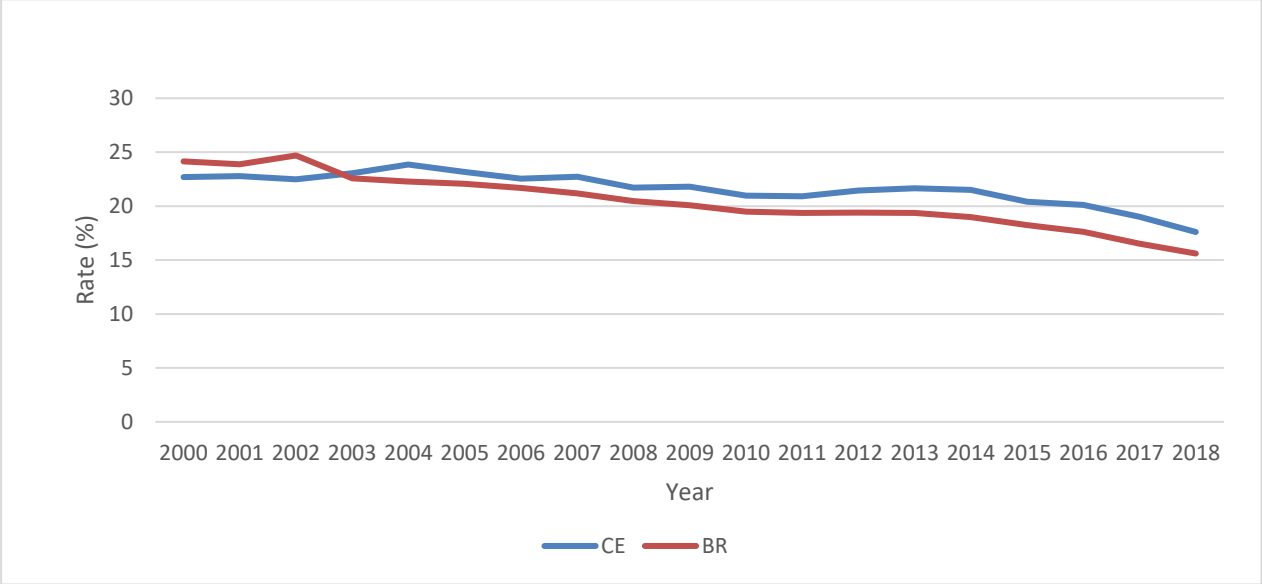
Figure 1 – FTS enrollment by sex (2008-2018)



Source: personal creation based on SEDUC Data

According to DATASUS, the average rate of young pregnant women aged 15 to 19 in Ceará was 21.6 percent from 2000 to 2018. As Figure 2 shows, from 2003 onwards, the rate of early pregnancy in Ceará exceeded the national rate, remaining so throughout the series analyzed. The average rate of early pregnancy in Brazil was 20.4 percent in the same period. We observe that there has been a decrease in the teenage pregnancy rate over the sample period.

Figure 2 – Brazil's and Ceará's average adolescent pregnancy rate.



Source: personal creation based on DATASUS

We can observe the characteristics of the treated and control groups (never-treated municipalities) for the outcome variables and predetermined variables (Table 2). The pregnancy rate for women aged 15 to 19 did not present a statistically significant difference in means between the treated and control groups, with a difference of 0.033 percentage points. Another

outcome variable tested for robustness (the placebo test) is the pregnancy rate for girls aged 10 to 14. The results indicate that there is no difference between the average rates for the control group (1.11%) and treated group (1.15%), with a non-significant difference of 0.039 percentage points.

Table 2 – T test for mean on control variables (never-treated x treated)

Variables	Non-treated			Treated			Difference	P-value
	Obs.	Mean	Std. Dev.	Obs.	Mean	Std. Dev.		
Pregnancy rate (15-19)	1,710	21.62	3.966	1,786	21.58	3.049	.0335	0.779
Pregnancy rate (10-14)	1,710	1.111	.858	1,786	1.151	.556	-.039	0.102
GDP per capita (R$)	1,710	4247.2	1581.8	1,786	6020.7	4289.4	-1773.5	0.000
IFDM	1,077	.595	.0786	1,128	.619	.086	-.024	0.000
IVS	180	.522	.093	188	.510	.098	.012	0.233
Approval	1,080	81.67	6.887	1,128	79.53	7.184	2.144	0.000
Dropout	1,080	11.54	4.589	1,128	13.20	4.903	-1.664	0.000

Source: personal creation

The t test for the model's predetermined variables shows that there is a statistically significant difference in the covariates of GDP per capita and the Firjan Municipal Development Index (IFDM). The treated municipalities have a GDP per capita of R$ 5,936.43 on average. This is R$ 1,689.19 more than the control group's average. The municipal development for the treated group is, on average, 0.619, while the control group has an average of 0.595. A significant difference of 0.024, implying that treated municipalities are more developed. However, the social vulnerability index showed no difference in the means of the groups.

4.2 Econometric results

The panel A of Table 3 shows three models estimating the Average Treatment Effect (ATE) on treated municipalities, considering a not-yet treated control group. The model (1) includes no covariates, and the estimated effect shows a reduction of 0.649 percentage points in the early pregnancy rate. When socioeconomic covariates were included in model (2), the impact of 0.542 percentage points on reducing adolescent pregnancy rate was statistically significant. The main finding is from model (3), which also included educational covariates in estimation. The causal impact of the full-time high school program on reducing the early pregnancy rate in Ceará was 0.849 percentage points, from 21.6% to 20.75% in Ceará's average early pregnancy rate.

Table 3 – Average Treatment Effects on treated considering the inclusion of covariates

Not yet treated (A)			
	(1)	**(2)**	**(3)**
ATE	-.649	-.542	-.849
	[-1.152; -.145]	[-1.069; -.015]	[-1.448; -.251]
GDP per capita	N	S	S
Firjan (IFDM)	N	S	S
Educational covariates	N	N	S

Number of municipalities	184	184	184
Number of groups (G)	11	11	11
Number of periods (T)	19	19	19
Never treated (B)			
	(1)	**(2)**	**(3)**
ATE	-.562	-.447	-.080
	[-1.080; -0,043]	[-1.016; .120]	[-.711; .551]
GDP per capita	N	S	S
Firjan (IFDM)	N	S	S
Educational covariates	N	N	S
Number of municipalities	184	184	184
Number of groups (G)	11	11	11
Number of periods (T)	19	19	19

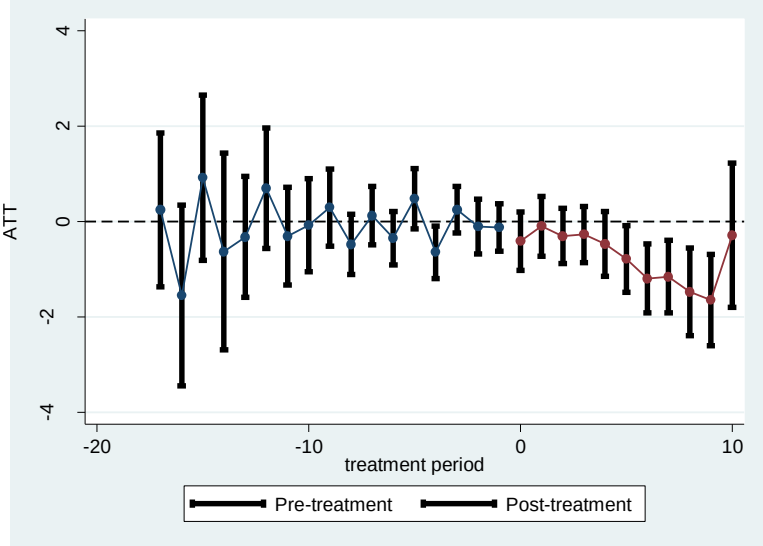
Source: personal creation. The 95% confidence interval for the estimates is shown between brackets.

We need to address the "overlap assumption" ***(Callaway & Sant'Anna, 2021)***. According to this assumption, we must be able to identify a municipality with a propensity score in the period t that is comparable to each municipality beginning their treatment in the period g. When using the untreated as a control group, it is difficult to address this assumption because there are fewer municipalities as time goes on. Table 3's Panel B addresses this issue by using the never-treated group as the control group.

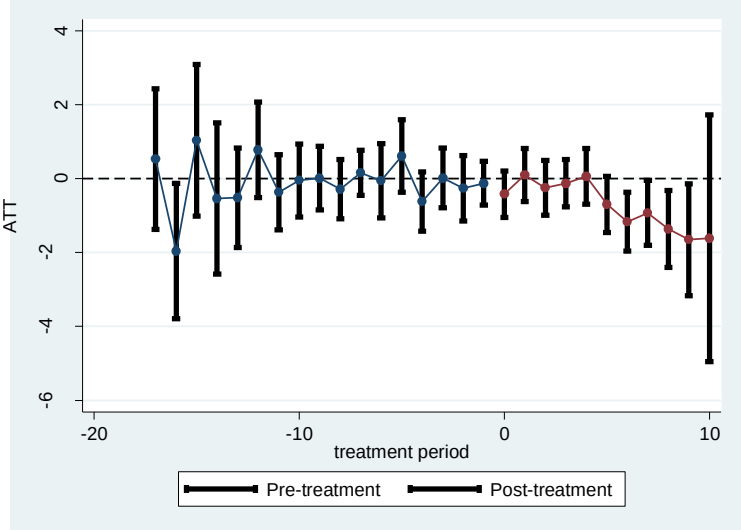
Model (1) presents a statistically significant negative impact of educational FTS program on early pregnancy (-0.562 percentage points). Although models (2) and (3) show negative impacts, the magnitude is not different from zero.

Observing the dynamic effects of the implementation of the FTS, Figure 3 shows the impact of the full-time school by the time of exposure to the treatment. Figure 3a represents model (1), without covariates; Figure 3b represents model (2), which considered the socioeconomic predetermined covariates; and Figure 3c presents model (3), considering socioeconomic and educational covariates.

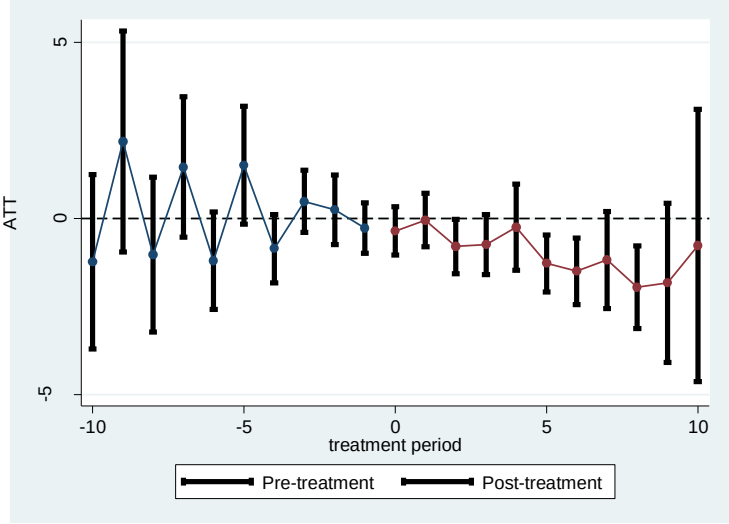
Figure 3 – Exposure to treatment time (*not-yet* treated)



(a) Covariates: None



(b) Covariates: GDP per capita and IFDH



(c) Covariates: GDP per capita, IFDH, Approval, Dropout rate, and CREDE

Figure 3a points out that there is an effect of educational public policy in model (1) from the fifth year of exposure. In model (2), the implementation of the FTS has a statistically significant effect on treated municipalities by the sixth year of exposure to treatment. The dynamic effect varies from -0.923 to -1.651 percentage points, reducing the early pregnancy rate (Figure 3b). Finally, Figure 3c shows that the effects of the implementation of full-time schools begin in the fifth year of exposure to the treatment. The implementation of a FTS in treated municipalities reduces teenage pregnancy rates by 1.183 to 1.953 percentage points, depending on the timing of exposure. The two last periods of treatment had no effect, probably because of the overlap.

5 Robustness

In order to test the robustness of the model, a placebo test was performed, replacing the dependent variable with the pregnancy rate for the age group of 10 to 14 years. As this public does not attend high schools, it is expected that the treatment variable is not statistically significant.

As shown in Table 4, there is no impact of the educational public policy on the pregnancy rate in this age group, both for municipalities in the *not-yet* control group and the *never-treated* control group. The estimated model replicates model 3 in the main results. Test results indicate that the model is robust.

Table 4 – Placebo test based on the early pregnancy rate of girls aged 10 to 14 years old

Not-yet treated		***Never treated***	
ATE	.099	ATE	-.012
	[-.127; .325]		[-.265; .239]
GDP per capita	S	GDP per capita	S
Firjan (IFDM)	S	Firjan (IDH)	S
Educational covariates	S	Educational covariates	S
Number of municipalities	184	Number of municipalities	184
Number of groups (G)	11	Number of groups (G)	11
Number of periods (T)	19	Number of periods (T)	19

Source: personal creation. The 95% confidence interval for the estimates is shown between brackets.

After this analysis, the methodology was changed to a model with panel data with fixed effects and clustering in the municipalities. The treatment variable was also changed to the percentage of students in full-time secondary schools in relation to the total number of students in this stage of public education.

Table 5 – Robustness model considering the percentage of full-time high school students using panel data with fixed effects

Early pregnancy rate (15 to 19 years old)	
% FTS student	-.033
	[-.0517; -.0145]
GDP per capita	S
Population	S
Educational variables	S
Number of municipalities	184
Number of groups (G)	11
Number of periods (T)	19

Source: personal creation. The 95% confidence interval for the estimates is shown between brackets.

In Table 5, the impact of the full-time school program on the teenage pregnancy rate was negative and statistically significant. The magnitude of the effect reveals a reduction of 0.033 percentage points on the outcome variable. This indicates that an increase of 1 p.p. in the percentage of students in full-time secondary schools reduces the early pregnancy rate by 0.033 percentage points. Therefore, the model is robust to changes in methodology and even to changes in the treatment variable.

6 Heteronegenous effects

A heterogeneity test was carried out, given that the effect of the average may not always be associated with the effects of subsamples. We wanted to check if municipalities with a lower Socioeconomic Vulnerability Index (IVS) had a different effect on educational policy in relation to those with a higher Socioeconomic Vulnerability Index (IVS).

Table 6 – Heterogeneity

Not-yet treated		***Not-yet treated***	
IVS=25%		**IVS=75%**	
ATE	.1117	ATE	-.497
	[-.952; 1.176]		[-1.829; .834]
GDP per capita	S	GDP per capita	S
Firjan (IFDH)	S	Firjan (IFDH)	S
Educational variables	S	Educational variables	S
Number of municipalities	51	Number of municipalities	45
Number of groups (G)	11	Number of groups (G)	11
Number of periods (T)	19	Number of periods (T)	19

Source: personal creation. The 95% confidence interval for the estimates is shown between brackets.

The model (3) of the main results was tested in two subsamples: i. 25% of the municipalities with the lowest IVS; and ii. 25% of the most vulnerable municipalities. Table 6 indicates that there is no impact of the full-time school policy on the teenage pregnancy rate in the subsamples.

7 Conclusion

Full-time secondary education is a public policy implemented in Ceará since 2008 that has been encouraged in its expansion in the various municipalities. The impact of this policy is ambiguous, not only on educational outcomes, such as dropout and school performance, but also on other aspects that this policy may entail, such as socioemotional development, impact on crime, and, in the case of this research, on early pregnancy for the age group of 15–19 years old.

We used the difference-in-differences method with multiple time periods because the implementation of the FTS was staggered in the municipalities of Ceará. The results show that the introduction of full-time secondary schools generates a reductive impact on the teenage pregnancy rate of 0.849 percentage points for treated municipalities. Taking into account that the average adolescent pregnancy rate in Ceará is 21.6%, the implementation of the FTS would reduce it to 20.75%, which implies an average reduction of 3.5% in the youth pregnancy rate.

The dynamic effects of the implementation of full-time schools begin in the fifth year of exposure to the treatment. The implementation of a FTS in treated municipalities reduces teenage pregnancy rates by 1.183 to 1.953 percentage points, depending on the timing of exposure. As educational policies become more consolidated, the magnitude of their impact grows.

A placebo test was performed, replacing the dependent variable with the pregnancy rate for the age group of 10 to 14 years. As this public does not attend high schools, it is expected that the treatment variable is not statistically significant. Considering both control groups, not-yet treated and never-treated, test results indicate that the model is robust. Another robustness test modified the method by applying panel data with fixed effects and clustering for the

municipalities as well as changing the treatment variable by inserting the percentage of full-time students in the municipalities. The impact of the full-time school program on the teenage pregnancy rate was negative and statistically significant. The magnitude of the effect reveals a reduction of 0.033 percentage points on the outcome variable

There are some limitations in this research, and the results must be viewed carefully because: i) Ceará's municipalities do not represent Brazil as well; ii) the state of Ceará has many educational public policies that are occurring at the same time, and there may be some confounding variables not captured by the model. More research is needed to understand the mechanisms behind the policy's effectiveness, the long-term impact on the students, and the optimal program design.

Other studies will be necessary to consolidate the literature on the various impacts that full-time educational policies can have. However, the robust results presented here suggest that policymakers should expand full-time secondary schools, prioritizing emotional and professional development, and working to reduce the rate of pregnant teenagers in Ceará.

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