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

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Abstract

Purpose – Adolescent pregnancy stands as a societal challenge, compelling young individuals to prematurely discontinue their education. Conversely, an expansion of high school education can potentially diminish rates of adolescent pregnancy, given that educational attainment stands as the foremost risk factor influencing sexual initiation, the use of contraceptive methods during initial sexual encounters and fertility. The aim of this paper is to analyze the impact of the implementation of the public educational policy introducing full-time schools (FTS) for high schools in the state of Ceará, Brazil, on early pregnancy rates.

Design/methodology/approach – Using the difference-in-differences method with multiple time periods, we measured the average effect of this staggered treatment on the treated municipalities.

Findings – The main result indicates a reduction of 0.849 percentage points in the teenage pregnancy rate. Concerning dynamic effects, the establishment of FTS in treated municipalities results in a 1.183–1.953 percentage point decrease in teenage pregnancy rates, depending on the timing of exposure. We explored heterogeneous effects within socioeconomically vulnerable municipalities, yet discerned no impact on this group. Rigorous tests confirm the robustness of the results.

Originality/value – This paper aims to contribute to: (1) the consolidation of research on the subject, given the absence of such research in Brazil to the best of our knowledge; (2) the advancement and analysis of evidence-based public policy and (3) the utilization of novel longitudinal data and methodology to evaluate adolescent pregnancy rates.

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

Paper type Research paper

1. Introduction

Teenage pregnancy, an urgent concern, notably affects developing countries. The fertility levels in adolescence (15–19 years old) in Latin America and the Caribbean significantly exceed the global average, with 61 births per thousand teenagers compared to the global average of 41 (Baker *et al.*, 2022).

The adolescent birth rates (birth rates per 1,000 women aged 15–19 years old) have decreased since the 1990s, albeit with varying rates across regions. Globally, the rate shrunk from 72.4 in 1990 to 43.6 in 2012, indicating a reduction of nearly 40%. In 2012, Europe and Central Asia reported the lowest rate of 13.1, a substantial drop from 35.5 in 1990. Conversely,

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Latin America and the Caribbean (LAC) exhibited the second-highest birth rate in 2012, climbing to 70.4, trailing only behind Sub-Saharan Africa, which recorded a rate of 98.8 (Santelli, Song, Garbers, Sharma, & Viner, 2017). More specifically, Latin American cities registered an average adolescent birth rate of 52.2 per 1,000 women aged 15–19 between 2014 and 2016 (Braverman-Bronstein *et al.*, 2022).

From 2004 to 2020, Brazil reported an average fertility rate of 49 births per thousand adolescents. According to the 2019 National Survey of School Health (PeNSE) conducted by the Brazilian Institute of Geography and Statistics (IBGE) [1], 35.4% of adolescents aged 13–17 engaged in sexual activity at least once. Among them, 7.9% of girls experienced pregnancy. This rate increased to 8.4% among adolescents attending public schools. The 2019 PeNSE survey further revealed that the northeast region of Brazil has a higher prevalence of adolescent pregnancy, with a rate of 10.9%.

Several risky factors contribute to the rise of this social problem, including lower education, misinformation about sexual prevention and a lack of parental guidance (Ahinkorah, Kang, Perry, Brooks, & Hayen, 2021; Cruz, Carvalho, & Guilherme Irffi, 2016; Jochim, Cluver, & Meinck, 2021; Kassa, Arowojolu, Odukogbe, & Yalew, 2018; Thobejane, 2015). In Latin America and the Caribbean, public policies related to conditional cash transfers and compulsory education show correlation with the prevention of adolescent pregnancy (Ribas, 2021). In the United States, mandating teenagers to stay in school until the age of 16 reduces the likelihood of pregnancy before the age of 20 by 4.7% (Black, Devereux, & Salvanes, 2008).

Specifically regarding education, full-time schooling (FTS) is a public policy that aids in the personal and professional development of high school students (Mariano & Arraes, 2018; Pires & Urzua, 2010). While 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 indicate positive effects (Figlio, Holden, & Ozek, 2018; Long, 2014; Sánchez & Favara, 2019; Wu, 2020). Other studies suggest ambiguous or non-existent effects (Battistin & Meroni, 2016; Folsom *et al.*, 2016; Jensen, 2013).

Concerning early pregnancy, adolescent birth rates (birth rates per 1,000 women aged 15 and 19 years old) have been declining since the 1990s; however, the rate of decline varies across regions. The global rate was 72.4 in 1990 and dropped to 43.6 in 2012, a reduction of almost 40%. In 2012, Europe and Central Asia reported the lowest rate at 13.1, compared to 35.5 in 1990. Latin America and the Caribbean (LAC) had the second-highest birth rate in 2012 at 70.4, trailing only Sub-Saharan Africa at 98.8 (Santelli *et al.*, 2017). Specifically in Latin American cities, between 2014 and 2016, the average adolescent birth rate was 52.2 per 1,000 women aged 15–19 (Braverman-Bronstein *et al.*, 2022).

The relationship between education and early pregnancy adds a tricky aspect due to the endogeneity between variables. On one hand, studies point out that expanding secondary education can contribute to a reduction in teenage pregnancy rates (Berthelon & Kruger, 2011; Black *et al.*, 2008; Leite, Rodrigues, & Fonseca, 2004; Santos & Pazello, 2012). In Chile, for instance, a 20% increase in full-time school enrollment reduces the likelihood of early pregnancy by 5% (Kruger & Berthelon, 2009). These findings are supported by additional studies (Berthelon & Kruger, 2011; Pires & Urzua, 2010). Moreover, the temporary closure of high schools during a student strike in 2011 in Chile resulted in an average 1.5% increase in teenage pregnancies (Celhay, Depetris-Chauvin, & Riquelme, 2022). In Peru, a school day extension program had a positive impact on preventing early pregnancy by influencing young people's educational aspirations and psychosocial skills (Sánchez & Favara, 2019). In Africa, where teenage pregnancy prevalence can reach 44.3% (Congo), the likelihood of early motherhood rises if the teenager has only primary education (Ahinkorah *et al.*, 2021).

In Brazil, evidence suggests that the expansion of access to secondary school between 1997 and 2009 resulted in a decrease in adolescent fertility. Increasing the number of schools per 100 women led to a reduction in female fertility by 0.25–0.563 births per 100 (Koppensteiner & Matheson, 2021). Education and income emerge as crucial indicators of variation in pregnant adolescents among the municipalities of the Legal Amazon (Santos, da Silva, Porfirio, da Silva, & de Brito, 2021). The socioeconomic profile shows that women between 10 and 19 with higher education are less likely to experience pregnancy (Cruz *et al.*, 2016).

On the other hand, while expanding access to school and the school day may impact early pregnancy, adolescent motherhood itself carries consequences that can jeopardize school performance, academic training and the future income of young people, often leading to school dropouts (Cerqueira-Santos, Paludo, dei Schirò, & Koller, 2010; Jochim *et al.*, 2021; Masterson, Neild, & Freedman, 2021; Santos & Pazello, 2012). Early and unplanned pregnancy triggers 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 dropouts (Masterson, Wynter, & Huber, 2021).

In Brazil, adolescents with five or more years of education are 58% less likely to become parents compared to those with lower educational levels (Leite *et al.*, 2004). Furthermore, there is an estimated 19.4 percentage point reduction in the likelihood of a pregnant teenager attending school, and early pregnancy diminishes the probability of completing elementary school by 13 percentage points (Santos & Pazello, 2012). For instance, in the Brazilian cities of Salvador, Rio de Janeiro and Porto Alegre, a cross-sectional study involving 4,634 young people aged 18 and 24 indicates that the primary reason for young women discontinuing their studies is pregnancy and childbirth (Almeida, 2008). The absence of prevention programs and inadequate support for teenage mothers in schools also contribute to higher dropout rates (Avila, 2015). These findings highlight the significance of educational interventions and support systems in mitigating the impact of early pregnancy on educational outcomes.

In the Northeast region of Brazil, where adolescent fertility rates are higher, early pregnancy leads to more disruptions in school life. Furthermore, low education, a lack of professional experience and the responsibility of caring for children present obstacles in the pursuit of employment for these young individuals (Costa, Poloponsky, Rocha Andrade Silva, Russo, & Silva, 2021; Pereira, 2014; Sousa *et al.*, 2018). According to Ministry of Health data, 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% had mothers aged 15 and 19 years old in the country.

Considering the insights provided on early pregnancy and education, the objective of this article is to isolate and measure the impact of the implementation of full-time schooling on the teenage pregnancy rate in the municipalities of Ceará. In order to explore 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 considered 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 treatment effect on the early pregnancy rate in treated municipalities. We integrated data from various sources, including 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 unavailability of precise data regarding the exact year of implementation of the full-time school program in all Brazilian municipalities, the research is limited to municipalities in Ceará. Nevertheless, Ceará has stood out in implementing educational policies that have become a national example and have been expanded. Notably, among these policies is the Full-Time School (FTS) Program. Alongside assessing the Average Treatment Effect (ATT) on the treated, the study included an analysis of the dynamic effect concerning the duration of exposure to the treatment. The paper aims to contribute to: (1) consolidating research on the subject, given the absence of such research in Brazil to the best of our knowledge; (2) forwarding and analyzing evidence-based public policy and (3) using novel longitudinal data and methodology to evaluate adolescent pregnancy rates.

In addition to this introduction, the paper is structured as follows: Section 2 discusses the implementation of the full-time school program in Ceará; Section 3 outlines the methodology; Section 4 shows the results; Section 5 performs model robustness tests; Section 6 analyzes potential heterogeneous effects and Section 7 concludes with final considerations.

2. Context

Ceará, situated in northeastern Brazil, stands as one of the country's economically disadvantaged regions. Its territorial expanse spans approximately 149 thousand square kilometers, akin to Greece, and its population was roughly nine million in 2022, as reported by the IBGE. According to the Brazilian Institute of Economics (IBRE-FGV), Ceará's GDP per capita in 2019 amounted to $5,635 USD, equivalent to 49% of Brazil's GDP per capita ($11,500 USD). The Human Development Index (HDI) for Ceará is 0.68, which is considered medium development.

The state of Ceará has stood out in the implementation of educational policies that have become a national benchmark and have been extended, such as the Literacy Program at the Right Age (PAIC) and tax transfer incentives for municipalities achieving improved educational quality indices. In addition to these policies, there is the Full-Time Schools (FTS) program.

Two distinct FTS models exist: the State Schools of Vocational Education (SSVE), which initiated its implementation process in 2008, and the Full-Time High Schools (FTHS), whose implementation began in 2016. The SSVE aims to facilitate the entry of young individuals into the workforce. In 2008, the initial 25 schools were established based on four criteria: (1) Being situated in a municipality with a Regional Education Development Coordination (CREDE); (2) Being located in socially vulnerable areas; (3) Displaying lower-than-expected educational indicators, prompting its revitalization and (4) Possessing the minimum infrastructure required for deployment.

The State Schools of Vocational Education (SSVE) received funding from the federal government through the *Programa Brasil Profissionalizado*. As of 2019, there were 122 school units in 95 municipalities, with 55,000 students enrolled, constituting approximately 20% of the total number of students in secondary state public education. These schools offer technical courses in various fields of activity during the after-shift period, totaling 52 courses [2]. The professional curriculum is relatively less flexible, and students continue through the three years of high school on the same course [3]. It's important to note that not all full-time schools in the state have programs specifically aimed at workforce training, but they share similar classroom workloads.

The Full-Time High Schools (FTHS) were implemented in 2016. The primary distinction between these two types of full-time education include: (1) The student selection and admission process, where the SSVE considers performance in lower secondary school, which is not a requirement for FTHS; (2) The presence of an after-shift course at the SSVE specifically focused on professional training and preparing students for the labor market. FTHS features a more flexible and comprehensive curriculum, designed to reinforce cognitive performance in core subjects from the Common Curriculum Base during the after-school period. Additionally, it adopts a holistic approach, incorporating subjects aimed at developing socio-emotional skills.

The FTHS implementation process started in 2015 when the Ceará state government [4] established criteria for school eligibility to participate in the program. The criteria included: (1) Being situated in a populous municipality; (2) Having 50% of students in socioeconomic vulnerability; (3) Ensuring at least 60% of vacancies are 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, allowing students to choose the type of school.

While FTHS is a public policy designed to enhance the academic performance of high school students, impacting standardized tests in mathematics and reading (Mariano & Arraes, 2018), it has the potential to generate spillover effects on various social outcomes beyond education.

3. Methodology

3.1 Databases

For this research, data was sourced from different databases for the 184 municipalities in the state of Ceará, including: (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 outlines the description of the variables used in the econometric models. The outcome variable, obtained from DATASUS data spanning from 2000 to 2018, represents the youth pregnancy rate as a percentage, as defined by the Ministry of Health. The variable is measured as follows:

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

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 (%)	The ratio of adolescents enrolled in full-time schools to the total number of adolescents in public schools	INEP
Treat	A binary variable indicating 1 if the municipality experince treatment 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 (%)	Approval rate of high school students in the municipality	INEP
Dropout (%)	Dropout rate of high school students in the municipality	INEP
CREDE	A binary variable indicating 1 if the municipality serves as the seat of regional education development coordination (CREDE) and 0 otherwise	SEDUC

Source(s): Table by authors

Table 1. Description of the model variables

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.

In the primary model, the treatment variable is defined at the municipal level as the year when the first Full-Time School (FTS) is established in the municipality. This administrative data was provided by the Secretariat of Basic Education of the State of Ceará, which, in turn, spatially delimited this study.

The model testing the robustness of the results utilized the percentage of full-time students as a treatment variable. This variable corresponds to the number of adolescents enrolled in full-time schools relative to the number of adolescents in public schools during the period 2000–2018.

The treat variable is represented as a binary indicator (0 or 1). A value of 1 indicates the presence of a FTS in that municipality, while a value of 0 indicates the absence of a Full-Time School during the period 2000–2018.

Finally, before the treatment initiates, predetermined variables are employed to control the level of economic development in each municipality. All values of predetermined variables must be measured prior to starting treatment in 2008, enabling the pairing and comparison with the control group. The inclusion of these variables in the model aims to capture the effects of the criteria used in selecting municipalities for the implementation of educational public policy.

The GDP per capita at constant prices for 2010 encompasses the period from 2000 to 2007. The Firjan Human Development Index (IFDH) measures the socioeconomic development of municipalities from 2005 to 2007, covering aspects such as income and employment, education and health. The index ranges from 0 to 1, with higher values indicating more developed municipalities.

To ensure comprehensive control, the model incorporates educational variables that serve as criteria for selecting treated municipalities. This includes assessing school quality through metrics like approval rate and dropout rate. The CREDE variable indicates the criteria used in selecting municipalities as seats of CREDE. Beyond those control variables, the 2000 Social Vulnerability Index (IVS) is employed to account for heterogeneous effects and compose subsamples. The IVS, a supplementary index to the Human Development Index (HDI), comprises 16 indicators related to urban infrastructure, human capital and labor and income dimensions. The Index ranges from 0 to 1, with higher values indicating greater social vulnerability in the municipality (Costa & Marguti, 2015).

3.2 Difference-in-differences method

The canonical difference-in-differences (DiD) method typically involves two time periods and two groups: no units receive treatment in the first period, and in the second period, some units are treated (treatment group). The method allows for estimating the Average Treatment Effect (ATT) on the treated by comparing the average change in outcomes. However, this method faces limitations when dealing with staggered treatment of municipalities (Athey & Imbens, 2006; Callaway & Sant'Anna, 2021; Rosa, Bruce, & Sarellas, 2022).

To address this issue, we used the Difference-in-Differences (DiD) method with multiple time periods to analyze the average treatment effect on the treated group. This approach relies on certain assumptions regarding treatment anticipation behavior and conditional parallel trends. The ATT estimates the causal effect of educational public policy on the adolescent pregnancy rate in the municipalities of Ceará. Under these assumptions, the group-time ATT is nonparametrically identified (Callaway & Sant'Anna, 2021).

Three sufficient conditions related to treatment anticipation behavior and conditional parallel trends ensure the non-parametric identification of group-time average treatment effects: (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 asserts that once a unit is treated, it remains treated in subsequent periods. In the context of this study, this means that once a Full-Time School (FTS) is established in a municipality, it will always function as a full-time school, and the unit cannot revert to any other teaching modality. The administrative data provided by SEDUC shows that there has been no reversal in treatment for any of the treated municipalities.

The second condition implies an independent and identically distributed sample (IID). As proposed by Callaway and Sant'Anna (2021), this assumption can be addressed through the use of panel data. This allows us to treat potential outcomes as random, without imposing restrictions between potential outcomes and treatment allocation, and without constraining the time series dependence of the observed random variables.

Finally, the third hypothesis of the identification problem involves limiting treatment anticipation. The assumption is addressed by the fact that the 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. Firstly, we compare the treated group of municipalities at the time g with a group of municipalities that had not yet adopted the program (*not-yet*). A distinct difference-in-differences was estimated for each year t, implying that the control group changes over time. Secondly, 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 established in year g, a municipality i is considered treated. Thus define G as the time period when a unit first becomes treated and $\boldsymbol{G} = \infty$ if a unit does not participate in any time period. In the t periods prior to the implementation of the school, this municipality was considered untreated $(\boldsymbol{D_i} = \mathbf{0})\forall \boldsymbol{t} < \boldsymbol{g}$. According to the irreversibility of the treatment assumption, $(\boldsymbol{D_i} = \mathbf{1})\forall \boldsymbol{t} \geq \boldsymbol{g}$.

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

$$ATT(g,t) = E[Y_t(g) - Y_t(0)|G_g = 1] \tag{2}$$

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

$$ATT(g,t) = E[X, G = g] - E[Y_t - Y_{g-1}|X, D_t = 0, G \neq g] \tag{3}$$

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

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

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

$$ATT(g,t) = E[X, G = g] - E[Y_t - Y_{g-1}|X, C = 1] \tag{5}$$

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

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

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 dynamic effects of treatment exposure will also be graphically presented for e periods, as follows:

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

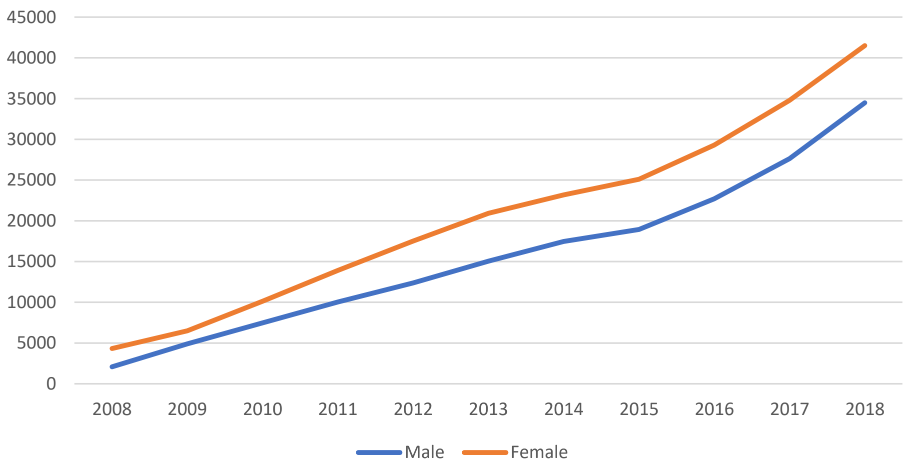
4. Results

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, Hatrick, & Llambi, 2022; Rosa, Bettinger, Martin, & Dantas, 2022). Spillover effects from full-time school have been less explored, suggesting that Full-Time School (FTS) may impact a student's life beyond cognitive aspects. Non-cognitive issues involving social relationships (such as crime and early pregnancy) and socioemotional aspects should also be considered.

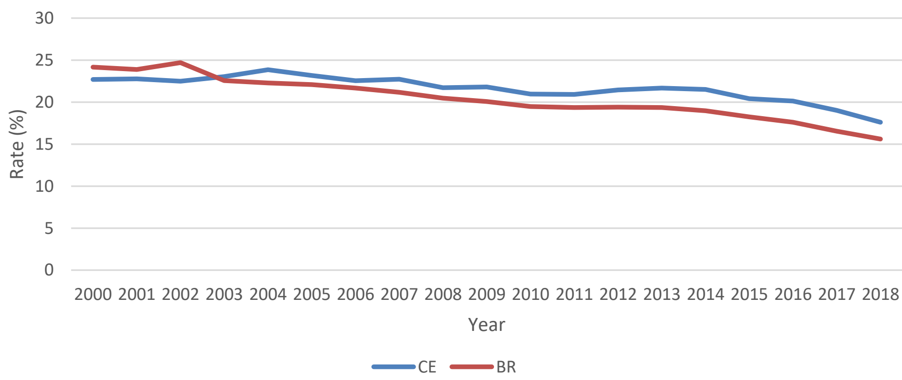
Figure 1 illustrates a longitudinal series of full-time high school student enrollment from 2008 to 2018, categorized by gender. We observe that there is a greater participation among young females in full-time education. Additionally, an inflection point in the enrollment curve is noticeable from 2015 onwards.

According to DATASUS, the average rate of young pregnant women aged 15–19 in Ceará was 21.6% from 2000 to 2018. As depicted in Figure 2, starting from 2003, the rate of early



Source(s): Figure by authors

Figure 1.
FTS enrollment by gender (2008–2018) based on SEDUC data



Source(s): Figure by authors

Figure 2. The average adolescent pregnancy rate for Brazil and Ceará, as reported by DATASUS (Ministry of Health)

pregnancy in Ceará surpassed the national rate and continues to do so throughout the analyzed period. The average rate of early pregnancy in Brazil during the same period was 20.4%. Notably, there has been a decline in the teenage pregnancy rate over the sampled period.

We can observe the characteristics of both the treated and control groups (never-treated municipalities) concerning outcome and predetermined variables, as shown in Table 2 [5]. The pregnancy rate among women aged 15–19 did not present a statistically significant difference in means between the treated and control groups, with a marginal difference of 0.033 percentage points. Another outcome variable subjected to robustness testing (placebo test) is the pregnancy rate among girls aged 10–14. The results suggest no significant distinction between the average rates for the control group (1.11%) and the treated group (1.15%), with a non-significant difference of 0.039 percentage points.

The *t*-test for the model's predetermined variables shows a statistically significant difference in the covariates of GDP per capita and the Firjan Municipal Development Index (IFDM). On average, the treated municipalities exhibit a GDP per capita of R$ 6,020.70, which is R$ 1,773.50 higher than the control group's average [6]. The municipal development for the treated group averages at 0.619, while the control group averages 0.595. This results in a significant difference of 0.024, indicating that treated municipalities are more developed.

	Non-treated			Treated				
Variables	Obs	Mean	Std. Dev	Obs	Mean	Std. Dev.	Difference	*p*-value
Pregnancy rate (15–19)	1,710	21.62	3.966	1,786	21.58	3.049	0.0335	0.779
taxa gravidez (10 a 14 anos)	1,710	1.111	0.858	1,786	1.151	0.556	−0.039	0.102
PIB per capita (R$)	1,710	4247.2	1,581.8	1,786	6,020.7	4289.4	−1773.5	0.000
IFDM	1,077	0.595	0.0786	1,128	0.619	0.086	−0.024	0.000
IVS	180	0.522	0.093	188	0.510	0.098	0.012	0.233
Approval	1,080	84.81	6.454	1,128	85.48	6.660	−0.675	0.015
Dropout	1,080	9.179	4.362	1,128	8.776	4.544	0.403	0.033

Source(s): Table by authors

Table 2. *T* test for mean on control variables (never-treated x treated municipalities)

However, there is no difference in the means of the social vulnerability index between the groups.

Additionally, the treated municipalities demonstrate better academic performance, with higher approval rates and lower dropout rates compared to the group that was never treated. These statistical differences show that predetermined covariates must be included in the model to control for differences between treated and control municipalities.

4.2 Econometric results

Panel A of Table 3 shows three models estimating the Average Treatment Effect (ATT) on treated municipalities, considering a not-yet treated control group. Model (1) includes no covariates, revealing an estimated effect of a 0.649 percentage point reduction in the early pregnancy rate. In Model (2), with the inclusion of socioeconomic covariates, the impact on reducing the adolescent pregnancy rate becomes statistically significant at 0.542 percentage points. As the differences in descriptive statistics from Table 2 suggest the necessity of incorporating program implementation criteria into the model, the primary finding arises from Model (3), which includes both educational and socioeconomic covariates. The causal impact of the full-time high school program on reducing the early pregnancy rate in Ceará was estimated at 0.849 percentage points between treated and non-treated groups. To illustrate this impact on Ceará's average early pregnancy rate and provide an interpretable result, the reduction would be from 21.6% to 20.75%, indicating a 3.5% decrease in the average early pregnancy rate in Ceará.

Not yet treated (A)	(1)	(2)	(3)
ATT	−0.649	−0.542	−0.849
	[−1.152; −0.145]	[−1.069; −0.015]	[−1.448; −0.251]
GDP per capita	N	Y	Y
Firjan (IFDM)	N	Y	Y
Educational covariates	N	N	Y
Number of municipalities	184	184	184
Number of groups (G)	11	11	11
Number of periods (T)	19	19	19
Number of observations	3,496	3,496	2,208
Never treated (B)	**(1)**	**(2)**	**(3)**
ATT	−0.562	−0.447	−0.080
	[−1.080; −0.043]	[−1.016; 0.120]	[−0.711; 0.551]
GDP per capita	N	Y	Y
Firjan (IFDM)	N	Y	Y
Educational covariates	N	N	Y
Number of municipalities	184	184	184
Number of groups (G)	11	11	11
Number of periods (T)	19	19	19
Number of observations	3,496	3,496	2,208

Note(s): Model (1) includes no covariates; Model (2) includes socioeconomic covariates; Model (3) also included educational covariates in estimation

The 95% confidence interval for the estimates is shown between brackets

Source(s): Table by authors

Table 3.
Average treatment effects on treated considering the inclusion of covariates

Panel A also addresses the "overlap assumption" as outlined by Callaway and Sant'Anna (2021). According to this assumption, it is crucial to identify a municipality with a propensity score in period t that is comparable to each municipality initiating treatment in period g. Models using the "not yet treated" as a control group are more likely to adhere to the "overlap assumption" since there is a substantial number of municipalities available to comparison. The "not-yet treated" category includes both the never treated and those units that, at a particular point in time, have not yet undergone treatment (Callaway & Sant'Anna, 2021).

In panel B, we changed the control group to the 90 municipalities that were "never treated" during the study time window (2000–2018). Therefore, this represents a more restricted group in comparison with treated municipalities. The models in panel B face a greater challenge in attending the "overlap assumption".

Model (1) presents a statistically significant negative impact of the educational FTS program on early pregnancy (−0.562 percentage points). However, in models (2) and (3), while negative impacts are observed, the magnitudes are not significantly different from zero. Therefore, differences between models 3A and 3B can be attributed to the variation in the comparison basis between treated and different control groups, with fewer municipalities available for comparison in panel B.

To observe the dynamic effects of FTS implementation, Figure 3 shows the impact of full-time school over time of exposure to treatment. Figure 3a corresponds to Model (1), without covariates; Figure 3b represents Model (2), which considers the socioeconomic predetermined covariates and Figure 3c presents Model (3), considering both socioeconomic and educational covariates.

Figure 3 includes pre-treatment estimates that serve as a control test for parallel hypotheses, along with estimates for the post-treatment effect. This approach is explicitly tied to the conditional parallel trends assumption, where the pre-treatment effect must have a zero effect. The lines in figure provide point estimates and simultaneous 95% confidence intervals for the treatment effect. Estimates of time-average treatment effects across pre-treatment periods in Figure 3 are not significantly different from zero, supporting the parallel trends hypothesis.

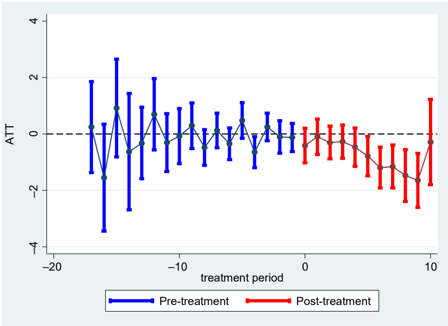
Figure 3a points out that there is an effect of educational public policy in Model (1) from the fifth year of exposure. In Model (2), the implementation of the FTS shows a statistically significant effect on treated municipalities by the sixth year of exposure to treatment. The dynamic effect ranges from −0.923 to −1.651 percentage points, reducing the early pregnancy rate (Figure 3b). Finally, Figure 3c illustrates that the effects of implementing 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 1.183–1.953 percentage point, depending on the timing of exposure. The two last periods of treatment had no effect, likely due to overlap.

5. Robustness [7]

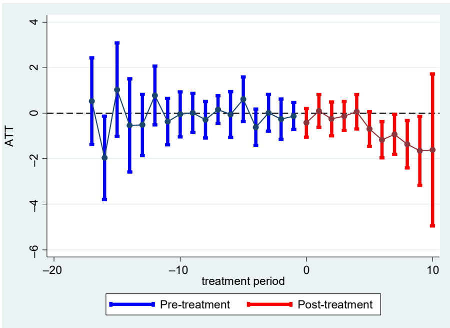
In order to assess the robustness of the model, a placebo test was performed, replacing the dependent variable with the pregnancy rate for the age group of 10–14 years. Since this population does not attend high schools, it is expected that the treatment variable would not be statistically significant.

As shown in Table 4, there is no impact of 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 suggest that the model is robust.

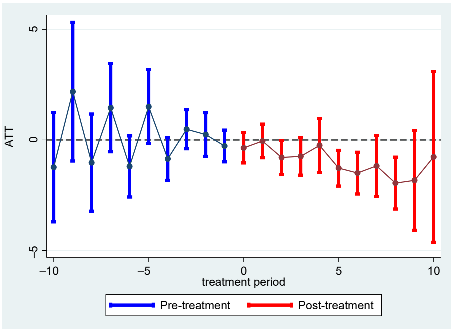
Following this analysis, the methodology was changed to a model with panel data with fixed effects and clustering at the municipality level. Additionally, the treatment variable was



(a)



(b)



(c)

Note(s): (a) includes no covariates,
(b) includes GDP per capita and IFDH,
(c) includes GDP per capita, IFDH, Approval,
Dropout rate, and CREDE

Source(s): Figure by authors

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

modified to the percentage of students in full-time secondary schools relative to the total number of students in this stage of public education.

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 indicates a reduction of

Not-yet treated		Never treated	
ATT	0.099 [−0.127; 0.325]	ATT	−0.012 [−0.265; 0.239]
GDP per capita	Y	PIB per capita	Y
Firjan (IFDM)	Y	Firjan (IDH)	Y
Educational covariates	Y	Educational covariates	Y
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
Number of observations	2,208	Number of observations	2,208

Note(s): The 95% confidence interval for the estimates is provided within brackets
Source(s): Table by authors

Table 4. Placebo test conducted using the early pregnancy rate of girls aged 10–14 years old

Early pregnancy rate (15–19 years old)	
% FTS student	−0.032 [−0.051; −0.013]
GDP per capita	Y
Population	Y
Educational variables	Y
Number of municipalities	184
Number of observations	2,208

Note(s): The 95% confidence interval for the estimates is shown within brackets
Source(s): Table by authors

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

0.032 percentage points in the outcome variable. This implies that an increase of 1-percentage point increase in the percentage of students in full-time secondary schools leads to a reduction of 0.032 percentage points in the early pregnancy rate. Hence, the model demonstrates robustness to changes in methodology and even alterations in the treatment variable.

6. Heterogeneous effects

A heterogeneity test was conducted, recognizing that the average effect may not always align with the effects observed in subsamples. The choice of the Socioeconomic Vulnerability Index (IVS) for assessing potential heterogeneous effects aimed to understand whether the reduction in early pregnancy rates is more focused on a group of more vulnerable municipalities or those that are less vulnerable.

To observe these heterogeneous effects concerning municipality vulnerability, the IVS was categorized into quartiles. The 25% with the lowest IVS (indicating less vulnerability) have an index less than or equal to 0.56, comprising a total of 51 municipalities. Conversely, the 25% with the highest IVS (indicating more vulnerability) have an index greater than or equal to 0.63, encompassing 45 municipalities. The objective was to examine whether municipalities with a lower Socioeconomic Vulnerability Index (IVS) exhibited a different effect on educational policy compared to those with a higher Socioeconomic Vulnerability Index (IVS).

Table 2 showed that the control and treatment groups are balanced for this covariate. Two t-tests were also performed for each of the subsamples, suggesting that in the tails of the index distribution there is also balance between the two groups.

The main model (3), illustrating the heterogeneous effects on two subsamples, is presented in Table 6. The findings suggest that the full-time school policy has no impact on the teenage pregnancy rate in either of the subsamples.

7. Conclusion

Full-time secondary education, implemented in Ceará since 2008, has been actively promoted for expansion across various municipalities. The impact of this policy can be multifaceted, affecting not only educational outcomes, such as dropout rates and school performance, but also influencing other aspects such as socioemotional development, crime and, in the context of this research, early pregnancy rates among individuals aged 15–19.

We used the difference-in-differences method with multiple time periods, considering the staggered implementation of the full-time secondary schools in Ceará's municipalities. The results show a significant reduction in the teenage pregnancy rate of 0.849 percentage points for treated municipalities compared to not-yet treated ones. Although this represents the difference between treated and not-yet treated groups, directly measuring the program's effect on the percentage early pregnancy rate in the treated group is not feasible. Therefore, the Average Treatment Effect on the Treated (ATT) is examined on Ceará's average early pregnancy rate to provide an interpretable result. The reduction would be from 21.6% to 20.75%, signifying a 3.5% decrease in the average early pregnancy rate in Ceará.

The dynamic effects of implementing full-time schools emerge in the fifth year of exposure to the treatment. The establishment of a Full-Time School (FTS) in treated municipalities leads to a reduction in teenage pregnancy rates by 1.183–1.953 percentage points, depending on the timing of exposure. As educational policies become more consolidated, the magnitude of their impact grows.

To test the robustness of the model, a placebo test was performed by replacing the dependent variable with the pregnancy rate for the age group of 10–14 years. Since this age group 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, the test results indicate that the model is robust.

In another robustness test, the methodology was modified by applying panel data with fixed effects and clustering for the municipalities, and the treatment variable was changed by

Not-yet treated Lower vulnerability		Not-yet treated Higher vulnerability	
ATT	0.1117 [−0.952; 1.176]	ATT	−0.497 [−1.829; 0.834]
GDP per capita	Y	GDP per capita	Y
Firjan (IFDH)	Y	Firjan (IFDH)	Y
Educational variables	Y	Educational variables	Y
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
Number of observations	599	Number of observations	518

Note(s): The 95% confidence interval for the estimates is shown within brackets
Source(s): Table by authors

Table 6.
Heterogeneity effects

incorporating 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 0.032 percentage points in the outcome variable. It's crucial to note that these results are not directly comparable to the main model results due to the changes in methodology and treatment variables. However, they hold significance as robustness test, demonstrating the stability and reliability of the findings under different analytical approaches.

There are some limitations in this research, and the results should be interpreted cautiously because: i) Ceará's municipalities may not be representative of Brazil as a whole; ii) the state of Ceará has numerous concurrent educational public policies, such as municipal initiatives for preventing teenage pregnancy developed internally in each municipality. However, there is no evidence to suggest that the creation of these policies coincides with the years of full-time schools implementation in the municipalities, potentially influencing our results. Further research is required to understand the mechanisms behind the policy's effectiveness, its long-term impact on the students and the optimal program design.

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

Notes

1. Available in: https://educa.ibge.gov.br/jovens/materias-especiais/21457-a-saude-dos-adolescentes.html
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.
4. Available at: https://www.seduc.ce.gov.br/escolas-de-ensino-medio-em-tempo-integral-eemti/
5. It is important to highlight that comparing the difference in the variable averages between treated and control municipalities becomes challenging due to the gradual implementation of public policy. The composition of the treatment and control groups varies annually, making direct comparison difficult.
6. The variance in GDP per capita was expected, given that one of the criteria for establishing a full-time school is the municipality's population size. When the outlier municipality of Fortaleza is excluded from the sample, the disparity in the average GDO per capita diminishes. Nonetheless, the variable continues to be statistically higher among the treated municipalities, with a difference of R$ 1,689.20).
7. Furthermore, it is important to highlight that the results of robustness tests are not directly comparable to the main results, as other variables and methodologies are employed. However, the direction of the results is consistent.

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