School Calendar and Suicides: Evidence for Argentina

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Abstract

In this work I examine the impact of the school calendar on suicides in adolescents (10-19 years) in a developing country -Argentina-. To do this, I use a regression discontinuity design based on suicide administrative data that allows me to exploit the temporal and geographical variability in the start date of the school calendar. The results confirm the existence of a negative impact of the school calendar on adolescent suicide in Argentina. In the days after the beginning of the school year, the number of deaths by suicide is reduced by 35% in relation to the previous days. The mechanism analysis, which exploits the shock of the COVID-19 pandemic, shows that the presence of parents in the household operates as a protective factor that reduces the number of suicides. These results are robust against age placebos (*i.e*., there are no differences in the number of suicides between older cohorts who presumably have already finished their school years) and temporal placebos (i.e., there are no differences when considering dates other than the actual school start date). These findings have important implications for educational policy.

Keywords: suicides, school calendar, adolescents, administrative data, Argentina.

1. Introduction

Every year, more than 700,000 people commit suicide globally -this is one of the leading causes of death among adolescents- (World Health Organization, 2023), and its frequency has increased in recent decades (United Nations Children's Fund, 2019). Given the prevalence of suicides, prevention is a policy and research priority. In this regard, the literature has shown robust evidence in relation to factors that predict the risk of suicide: drug and alcohol consumption (Carpenter, 2004; Ilgen, 2019; Miller & Coffey, 2021), access to firearms (Donohue, Cai & Ravi, 2023), the family environment (Resnick *et al*., 1997; Perkins, 2002; Sabia & Rees, 2012; Fang *et al*., 2023), gender (Beautrais, 2002; Coleman *et al*., 2020; Shelef, 2021), history of abuse or discrimination (Rees, Sabia & Kumpas, 2022; Marcotte & Hansen, 2023), unemployment (Breuer, 2015), inequality (Daly, Wilson & Johnson, 2013), income (Christian, Hensel & Roth, 2019), among others. A review of these determinants can be found in Marcotte & Zejcirovic (2020) and Stack (2021).

A determinant that has received relatively little attention in the literature is the school calendar -delimited by class start and end dates. The impact of the start of school on adolescent suicide is ambiguous. On the one hand, school can constitute a space of support for adolescents and thus reduce the risk of suicide. On the other hand, school can worsen mental health and increase the risk of suicide due to stress from schoolwork or being in a harmful environment (e.g., due to bullying). Empirical evidence on this topic is scarce and focuses only on developed countries.

Hansen & Lang (2011) examine the relationship between the school calendar and suicides in adolescents in the United States for the 1980-2004 period. The authors provide correlational evidence showing that suicides increase substantially in school months and decrease in recess months (the authors do not have daily data). Differences in climate or economic factors do not explain the results. For the same country, Hansen *et al*. (2023) show similar results when exploiting the variability in the attendance format (in-person *vs*. remote) imposed by the COVID-19 pandemic. The authors report a drop in suicides at the beginning of the pandemic that coincided with school closures and a subsequent increase.

Tanaka & Okamoto (2021) use a difference-in-differences estimate and report for Japan that the suicide rate among adolescents decreased by 49% during school closures due to the COVID-19 pandemic. Subsequently, with the reopening of schools, the suicide rate increased—especially among women. Matsubayashi, Ueda, and Yoshikawa (2016) also reported similar results for Japan. However, the authors warn that for that country, there is little temporal and geographical variability in the start dates of the school calendar.

Regarding mechanism analysis, Bacher-Hicks *et al*. (2022) point out that online searches related to bullying and cyberbullying in the United States follow the school calendar, with a peak during this period and a decrease during school breaks. Additionally, depression, suicidal ideation, and suicide attempts were significantly correlated with experiences of victimization and bullying, both within and outside of the school environment. In this regard, evidence has shown that greater exposure to bullying, whether as a victim of bullying or as a perpetrator, consistently correlates with a greater risk of developing depression, suicidal thoughts, and suicide attempts (Brunstein Klomek *et al*., 2007).

In this context, the objective of this work is to analyze the impact of the school calendar on suicides in adolescents in a developing country -Argentina-. The identification strategy relies on a regression discontinuity design that allows for exploiting the temporal and geographical variability in each province's school year start date. In Argentina, a federal country, education is the responsibility of each of the 24 provinces, and each decides the exact time of the start of the school year. This provides the variability necessary to implement the identification strategy.

In this work, I use administrative police records of suicides provided by the Ministry of National Security and records of the start dates of classes in each province and year. The advantage of using police records, rather than hospital records or self-reports of mental health, is to avoid measurement errors arising from better recording of mental health problems in more recent years. As the study of Corredor-Waldron & Currie (2023) suggests, increases in reports of suicidal behaviors may be due to changes in the detection and coding of these behaviors without necessarily indicating genuine worsening.

The results of the work confirm the existence of a negative impact of the school calendar on adolescent suicide in Argentina. In the days after the start of the school year, the number of deaths from adolescent suicide decreases significantly. This translates into a reduction in the number of teenage suicides by 35% in relation to the days before the start of the school year. These results are robust to multiple checks: age placebos (for cohorts that have already finished their school years), temporal placebos (for days other than the start of classes), and different bandwidths and kernels. The analysis of mechanisms shows that the presence of parents at home operates as a protective factor that reduces the number of suicides: those districts in which activity in work establishments was reduced the most during the COVID-19 pandemic -that is, districts with a higher proportion of the population working from home- show a lower number of suicides, in relation to those districts with higher in-person activity.

To the best of my knowledge, this work adds value to the suicide determinants literature in three aspects. First, it provides causal evidence for a developing country from the Global South (i.e., Argentina). Typically, the literature has focused on a few developed countries (United States and Japan). This responds to the greater availability of data in these countries. In this regard, school calendars differ widely (start in March in Argentina *vs*. August or September in the United States). Second, it explores a determinant little studied in the suicide literature (i.e., the school calendar). Literature has frequently explored determinants such as income, family environment, and climate. Third, this work provides evidence of the mechanisms that explain the results (i.e., the presence of parents in the household due to an exogenous shock). This has important implications for educational policy and the organization of the school year.

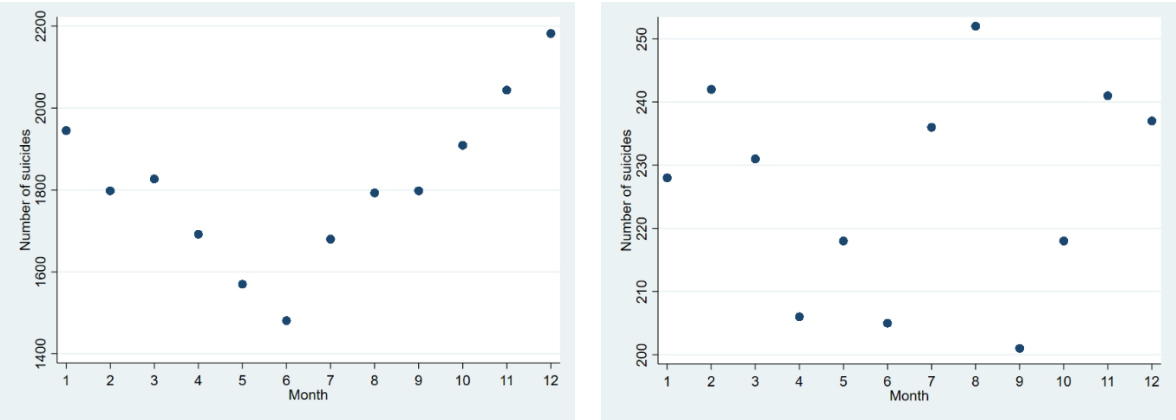
From now on, Section 2 describes the information sources used. Section 3 details the empirical identification strategy, while Section 4 presents the main results of the work. Finally, Section 5 presents the conclusions.

2. Sources of information

In this work, I combine four sources of information. First, I turn to administrative data from the Suicide Early Warning System (SAT), which collects information on suicides reported throughout Argentina in the 2017-2022 period. This is a component of the National Criminal Information System (SNIC), belonging to the National Directorate of Criminal Statistics (DNEC) of the Ministry of National Security (2023). Under this system, provincial police forces, federal security forces, and other official entities report events in a pre-established form format or by directly uploading their data to the website intended for this purpose (National Directorate of Criminal Statistics, 2023). These data allow me to identify the exact time and place of suicide occurrence with a high degree of spatial disaggregation (at the district level).

Figure 1 shows the number of suicides registered by month of the year in Argentina (2017-2022). For the complete sample (left panel), a seasonal pattern implies a decreasing trend in suicides from January to June, then increasing steadily until December. Among adolescents (10 to 19 years old), a less clear pattern with ups and downs is observed on the right panel.

Figure 1: Number of suicides per month in all ages (left) and adolescents (right)



Source: own elaboration based on the Ministry of National Security. Note: Months refer to January (month 1) through December (month 12).

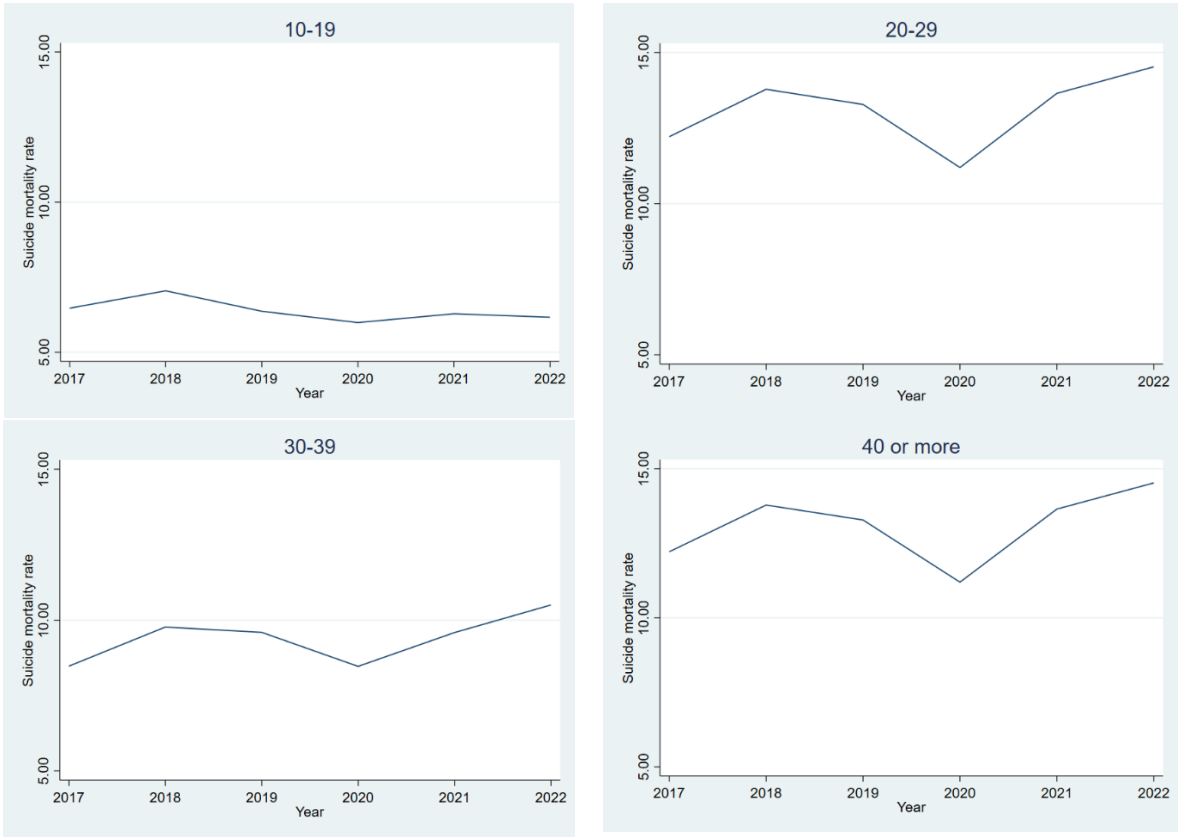
In the entire period (2017-2022), 21,719 suicides were recorded, of which 12.5% correspond to adolescents (10-19 years old). A wide gender difference is observed: 79% of suicides correspond to men. This proportion is 69% among adolescents.

The second source consists of a database that indicates the exact start date of the school period -that is, the beginning of classes- in each province and year during the period analyzed. These dates are collected from official provincial sites and news reports. In Argentina, the decision about the start date of classes is the responsibility of the education authority of each province. This allows me to exploit this source of variability (temporal and geographical) to study the causal impact of the school calendar on adolescent suicide. The variability in the start of classes between provinces reveals a maximum difference of 42 days in 2018. The earliest date recorded is February 1, while the latest is April 3. Thus, I identify the events that must be defined as treated because they occurred after the beginning of the school period and before its end.

Third, I incorporate the population projections by five-year age groups elaborated by the National Institute of Statistics and Censuses (INDEC, 2014). Combining these data with the microdata on suicide

deaths allows me to calculate the rates corresponding to each age range and their evolution, as illustrated in Figure 2.

Figure 2: Suicide mortality rate by age range in Argentina (per 100,000 inhabitants)



Source: own elaboration based on the Ministry of National Security and INDEC.

Finally, I use the mobility trend records provided by Google (2022). These data show how the number and duration of visits vary to places classified in different categories, such as workplaces, residential areas, public transport stations, shops, and recreational places (bars, restaurants, etc.). These are presented in comparison with a reference value corresponding to the median of that day of the week in the five weeks before February 7, 2020, approximately one month before the first case of COVID-19 in Argentina. The variable measures the relative activity in work establishments and takes values between -93 and 152. Given the high level of disaggregation of these at the district level (i.e., department, commune, or *partido*, depending on the jurisdiction) and its temporal frequency (daily), it is possible to obtain an approximation of the incidence of remote work and know its relationship with suicide.

3. Methodology

This work's identification strategy is based on a regression discontinuity design that allows me to exploit the school year's start date variability. The discontinuity is given by the start date of classes in each province and year. Therefore, I estimate equation 1. Here, each observation consists of a calendar day (d), which is standardized in relation to the start of classes so that day 0 is the start day. β_1 is the coefficient of interest and arises from the indicator variable $1(Day_d > Start)$ which takes a value of 1 for the days after classes start and 0 for the days before. Thus, β_1 captures the change in the number of suicides on days of the school season in relation to the previous days. $f(Day_d)$ is a linear function of the assignment variable. μ_d is the error term.

$$y_d = \beta_0 + \beta_1 1(Day_d > Start) + \beta_2 f(Day_d) + \mu_d \qquad (1)$$

The bandwidth is chosen by optimizing the trade-off between bias and variance, according to Calonico et al. (2020), and the results are robust when considering other bandwidths. A triangular kernel is used for the estimates -it attributes greater weight to days closer to the start date- and the results are robust compared to other kernels. Equation 1 is estimated considering the population between 10-19 years old - presumably in their school years-.

Equation 1 is re-estimated, implementing multiple robustness checks. Firstly, an age placebo is implemented by considering the age ranges of people who were presumably not in their school years at the time of the suicide (20-25 years, 25-29, and over 20 years). Second, a temporal placebo is implemented by defining four dummy thresholds, corresponding to 15 and 30 days before and after the baseline threshold. In none of these cases are significant differences expected. In addition, a breakdown is incorporated into two subperiods: 2017-2019 and 2020-2022. This periodization responded to the COVID-19 pandemic, which implied a change in the modality of class delivery and work (moving essentially from in-person to remote).

Finally, I estimate equation 2 to explore a potential mechanism behind the effects found. Using mobility data, I analyze the change in the number of suicides by district in relation to the relative openness of workplaces during the COVID-19 pandemic (2020-2022). The record of visits and duration in work establishments such as offices measures the proportion of the population doing home-office.

$$y_{id} = \beta_0 + \beta_1 Workplaces_{id} + \alpha_i + \gamma_d + \mu_{id} \qquad (2)$$

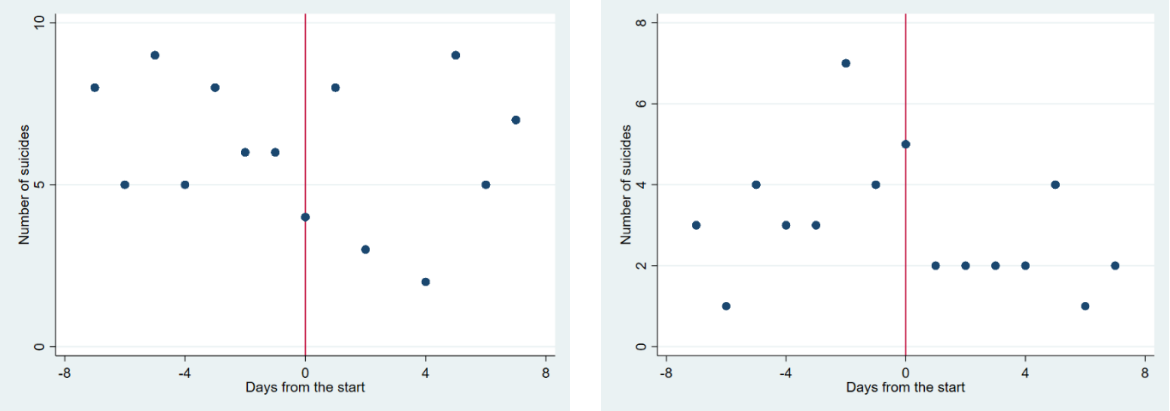
The coefficient β_1 arises from the $Workplaces_{id}$ variable represents the percentage variation in activity in establishments classified as workplaces in relation to the reference value (i.e., weeks before the pandemic's start). If the presence of parents at home acts as a protective factor for adolescent suicide, I should find a lower number of suicide deaths in those districts with more severe isolation measures and, therefore, less relative activity in workplaces. That is the coefficient. β_1 should be positive and significant. α_i and γ_d represent geographic and time-fixed effects.

The decision to analyze the threshold for the beginning of the school year without considering the thresholds for the end of classes and the beginning and end of the winter break is due to two issues. Firstly, the end of school threshold tends to be close to the festive period including Christmas and the New Year, events that have been shown to affect the suicide rate. At a general level, in European countries, the suicide rate decreases during Christmas and reaches a peak at New Year (Plöderl *et al*., 2015; Cavanagh *et al*., 2016; Hadlaczky & Hökby, 2018; Hofstra *et al*., 2018). In contrast, in Latin American countries such as Mexico and Colombia, a different pattern seems to be observed, with increases in the frequency of suicides both at Christmas and New Year's (Fernández-Niño *et al*., 2016; Nieto-Betancurt *et al*., 2023). Regardless of this phenomenon's direction in Argentina, including this date would introduce a bias in the estimates. Secondly, this decision responds to the seasonality linked to household income in July (winter break period) and December (end of the school year). In each of these months, formal workers receive, in addition to their usual remuneration, an extra 50% as complementary remuneration (known as *Aguinaldo* in Spanish). This could bias the results obtained.

4. Results

Figure 3 allows me to observe the discontinuity exploited in this work at the threshold of the start of classes. For both men and women, the data show a drop in the number of suicides almost immediately after the beginning of the school year.

Figure 3: Suicides in adolescents around the start of school



Source: own elaboration based on the Ministry of National Security. Note: days are standardized in relation to the start of classes (day 0 is the start day).

Table 1 presents the results that arise from estimating equation 1. From the preferred specification (column 1, which uses the optimal bandwidth), it emerges that the number of suicides decreases by a magnitude equal to 3 after the start of school. This implies a reduction in the number of adolescent suicides of 35% in relation to the days before the beginning of the school year. This result is robust against other bandwidths -larger or smaller- (columns 2 to 5).

Table 1: School calendar and adolescent suicide in Argentina (2017-2022)

	(1)	(2)	(3)	(4)	(5)
β_1	-3.0081* (1.5691)	-3.0175* (1.6126)	-2.9814* (1.5285)	-3.1563* (1.6801)	-3.024** (1.4722)
Bandwidth	36 days (Optimum)	34 days	38 days	31 days	41 days

Note: own elaboration based on the Ministry of National Security. Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Triangular kernel. Estimated optimal bandwidth with the rdrobust package (Calonico *et al*., 2014).

Table 2 arises from estimating equation 1, disaggregating by subperiods (2017-2019 and 2020-2022). First, it is observed that the school calendar has not had a significant impact on adolescent suicide in the period before the pandemic. However, the start of school has had a significant impact on teenage suicide in the post-pandemic period (2020-2022). This result is robust to different bandwidths and could be explained by the increase in one of the protective factors identified by the literature: the presence of parents (see Table 6). During the post-pandemic period, many people adopted teleworking in response to isolation measures, which gave them more time to be present at critical times of the day, possibly contributing to a more favorable and protective environment for adolescents.

Table 2: School calendar and adolescent suicide with multiple bandwidths

	2017-2019			2020-2022		
	(1)	(2)	(3)	(1)	(3)	(5)
β_1	2.7804 (2.9349)	2.1533 (2.7885)	1.2982 (2.687)	-3.6644* (1.9779)	-3.6165* (1.9389)	-3.5947* (1.867)
Bandwidth	28 days (Optimum)	30 days	32 days	36 days (Optimum)	38 days	40 days

Note: own elaboration based on the Ministry of National Security. Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Triangular kernel. Estimated optimal bandwidth with the rdrobust package (Calonico *et al*., 2014).

Table 3 presents the results from re-estimating equation 1, incorporating a breakdown by region. From there, it emerges that the Central region is the only one in which a significant drop in adolescent suicide is observed at the beginning of classes for the entire period. This relationship appears statistically significant in the Central and Northwest regions in the post-pandemic period (2020-2022) when disaggregating by subperiods.

Table 3: School calendar and adolescent suicide by region

		Centro	Patagonia	NEA	NOA	Cuyo
2017-2022	β_1	-3.0032*** (1.1209)	0.23731 (0.36964)	0.2316 (1.1382)	-1.4872 (0.94766)	-0.26266 (0.31047)
	Bandwidth	17 days (Optimum)	38 days (Optimum)	31 days (Optimum)	32 days (Optimum)	44 days (Optimum)
2017-2019	β_1	-1.825 (2.3808)	Insufficient observations	0.08543 (0.07388)	-0.93513 (1.541)	-0.24175 (0.25966)
	Bandwidth	23 days (Optimum)	-	34 days (Optimum)	30 days (Optimum)	47 days (Optimum)
2020-2022	β_1	-2.5387*** (0.89981)	0.8698 (0.82186)	1.5819 (2.2921)	-1.7579** (0.77834)	-0.79901 (0.57103)
	Bandwidth	25 days (Optimum)	30 days (Optimum)	32 days (Optimum)	47 days (Optimum)	48 days (Optimum)

Note: own elaboration based on the Ministry of National Security. Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Triangular kernel. Estimated optimal bandwidth with the rdrobust package (Calonico *et al*., 2014).

The above results are robust to the implementation of two placebos. The first is an age placebo that considers the age ranges of people who were presumably not in their school years at the time of the suicide (20-25 years, 25-29, and over 20 years). In these cases, no significant differences should appear. Table 4 shows that, in line with what was expected, significant results do not appear. The number of suicides does not vary significantly after the start of the school year in any other age range.

Table 4: Age placebo for school calendar and adolescent suicide

	20-24 y/o	25-29 y/o	≥20 y/o
β_1	-1.8205 (1.3679)	-0.96635 (2.5751)	-5.6503 (5.2631)
Bandwidth	29 days (Optimum)	28 days (Optimum)	23 days (Optimum)

Note: own elaboration based on the Ministry of National Security. Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Triangular kernel. Estimated optimal bandwidth with the rdrobust package (Calonico *et al*., 2014).

Secondly, I implement a time placebo that fictitiously advances and postpones the threshold for the start of classes by 15 and 30 days. Thus, if the drop in the number of suicides effectively responds to the beginning of classes, no significant differences should appear when considering other thresholds. In this case, neither coefficient is statistically significant. Table A.1 shows that the results are also robust when estimating using different kernels (uniform and Epanechnikov).

Table 5: Temporal placebo for school calendar and adolescent suicide

	-30 days	-15 days	+15 days	+30 days
β_1	1.0583 (1.0905)	-0.38534 (1.5042)	-0.48364 (1.6394)	1.6944 (1.5089)
Bandwidth	33 days (Optimum)	32 days (Optimum)	25 days (Optimum)	36 days (Optimum)

Note: own elaboration based on the Ministry of National Security. Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Triangular kernel. Estimated optimal bandwidth with the rdrobust package (Calonico *et al*., 2014).

Finally, I estimate equation 2 to explore the presence of parents in the household as a potential protective mechanism. Table 6 shows that there is a positive association between workplace activity and the number of suicides. This implies that in the districts where more individuals opted for teleworking or other hybrid modalities during the post-pandemic period (2020-2022), a lower number of suicides was observed, and vice versa. This result is robust to the incorporation of geographical and time-fixed effects.

Table 6: Teleworking and adolescent suicide

	(1)	(2)	(3)
Workplaces	0.0040909*** (0.00119)	0.0033161*** (0.0012095)	0.0050176*** (0.0012368)
Geographic fixed effects	No	Yes	Yes
Time fixed effects	No	No	Yes
N	8,801	8,801	8,801

Note: own elaboration based on the Ministry of National Security and Google. Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

The results reported here are consistent with the existence of a negative relationship between the school calendar and adolescent suicide. However, it differs in magnitude and sign concerning empirical work for developed countries. This highlights the importance of empirical research from the Global South. In the case of the United States, Hansen *et al*. (2023) reported a positive effect of the school calendar on adolescent suicide (12-18 years). In 2019 and 2020, the reopening of schools, either after a break or after their closure due to the COVID-19 pandemic, was associated with an increase in teen suicide. In this context, the authors explored bullying as a mechanism that could explain this dynamic. Similar results are reported for the case of Japan by Matsubayashi *et al*. (2016).

Consistent with this work, Björkegren *et al*. (2023) identified a 4.4% decrease in mental health service utilization among students who experienced periods of online education compared to pre-pandemic levels. Their findings suggest that this effect is not attributable to a reduction in access to health care but rather to a decrease in diagnoses of depression and anxiety, as well as antidepressant prescriptions. Furthermore, it is observed that the positive effects of remote education on mental health persist in the medium term.

5. Conclusions

In this work I have examined the impact of the school calendar on suicides in adolescents in Argentina. The results confirm the existence of a negative impact: in the days after the start of the school year, the number of deaths from adolescent suicide decreased substantially (-35% compared to the previous days).

The disaggregation by subperiods reveals that this relationship is statistically significant in the post-pandemic period (2020-2022). This period was marked by remote work and education, which affected the presence of parents at home. That is why I have implemented a check that allows me to know if those districts with the highest incidence of remote work have been those in which the suicide rate has fallen the most. Indeed, I confirm that there is a negative relationship between activity in the workplace and the number of suicides.

The results of this work are of particular relevance to educational policy. First, they highlight the importance of remote or hybrid education during compulsory schooling (primary and secondary). For this measure to be effective in improving mental health and reducing adolescent suicide, it must be combined with compatible work modalities for their parents (i.e., remote or hybrid work). This has proven beneficial: working from home generates time savings that are partially allocated to care activities, especially for those who live with children (Aksoy *et al*., 2023). In other words, the findings of this study suggest that remote work could generate positive externalities for children.

In the future, evaluating the impact of other determinants of adolescents' mental health is relevant based on the different modalities of school attendance. The suspension of in-person classes has undoubtedly influenced peer contact, generating possible changes in the prevalence of bullying victimization and alcohol consumption. On the other hand, although the micro database used incorporates a variable related to gender identity, it is observed to have an indeterminate value in almost 70% of the cases. Improving the collection of this information is essential to deepen the analysis.

The incorporation of other socioeconomic variables in the registry of deaths by suicide is also relevant. This would allow me to know possible disparities according to income levels. It is plausible that those adolescents from the lowest deciles will be forced to join the labor market to compensate for an eventual loss of income at home. In this sense, the responsibility regarding the economic support of the family may have acted as a deterrent factor against suicidal behavior. Similarly, reallocating caregiving tasks to children or older adults in the family group could have had a substantial impact. To achieve this, it is imperative to have a database that collects aspects of the family and economic composition of the victims.

Annex

Table A.1: School calendar and adolescent suicide under different kernels

	Uniform			Epanechnikov		
	2017-2022	2017-2019	2020-2022	2017-2022	2017-2019	2020-2022
β_1	-3.0152 (1.8796)	Insufficient observations	-4.5959* (2.3671)	-3.0078* (1.6766)	Insufficient observations	-3.7063* (2.04)
Bandwidth	22 (Optimum)	-	20 (Optimum)	29 (Optimum)	-	31 (Optimum)

Note: own elaboration based on the Ministry of National Security. Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Uniform kernel and Epanechnikov. Estimated optimal bandwidth with the rdrobust package (Calonico *et al*., 2014).

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