COVID-19 and suicides in the United States: an early empirical assessment

Gerardo Ruiz Sánchez

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Abstract
2017–2020 data from Medical Examiner Offices of 19 large U.S. counties are collected to study how suicides evolved during the early stage of the COVID-19 pandemic. I use these data to obtain three key findings. First, I document that the total number of suicides per month was increasing during the early months of the pandemic but was below previous years’ levels. Second, using a monthly event study design to account for seasonal trends and county-level differences in suicides, I find that during April through August 2020, monthly suicides were between 11.2 and 20.5% lower than previous years. Third, I explore whether school closures during the start of the pandemic might be associated with suicides among school-age individuals, and I find that monthly suicides increased relative to previous years for this age group, with the highest increases during the summer.

Keywords COVID-19 · Suicide · The United States

JEL Classification I10 · I14 · J38

Introduction
The COVID-19 pandemic led to an economic slowdown in the United States, and there is concern that the adverse economic effects of the pandemic have the potential to increase suicides among Americans (Reger et al. 2020). Moreover, social distancing, school closures, and stay-at-home policies may also increase the risk of suicide. Therefore, it is natural to ask how the COVID-19 pandemic is affecting the number of suicides in the United States and how they compare to previous years.

This paper provides an early empirical look at suicides in the United States during the COVID-19 pandemic using 2017–2020 data on suicides obtained from Medical Examiner Offices (MEOs) whose jurisdictions pertain to nineteen largely populated...
U.S. counties. By law, MEOs inquire and determine the circumstances, manner, and cause of sudden deaths (e.g., suicides). The Medical Examiner documents verified suicides in death certificates, which are later sent to the National Center for Health Statistics (CNHS) of the Centers for Disease Control and Prevention (CDC), where they are used to produce the nation’s official death statistics. Previous papers in the economics literature that study suicides (Dow et al. 2020; Ruhm 2019; Stevenson and Wolfers 2006) use CNHS’s Multiple Causes of Death individual level data. However, this is a restricted data set and the 2020 edition of the CDC’s suicide data is not yet available, prompting the need to look for an alternative data source to study suicides during the early stage of the pandemic.

I use the MEOs data to show that the total number of suicides per month in 2020 was increasing from April 2020 to August 2020. However, the number of suicides per month was below previous years’ levels starting in April 2020. Therefore, I use a set of monthly event study designs to estimate monthly changes in the number of suicides for the first 8 months of 2020 relative to 2017–2019 using March 2020 as the “event month.” The point estimates during April through August indicate decreases in the total number of suicides ranging from 11.2 to 20.5% relative to previous years. I also estimate the model restricting the sample by gender, and the point estimates indicate that the magnitude of the decrease in suicides was larger for females. Finally, I explore if school closures might be associated with suicides among school-age individuals. I find monthly increases in suicides that range from 8 to 43.1% with the highest increments during the summer.

This paper contributes to the economics literature studying suicides in the United States (Cutler et al. 2001; Dow et al. 2020; Case and Deaton 2020; Ruhm 2019; Stevenson and Wolfers 2006). I contribute to this literature by providing descriptive evidence of how suicides are evolving during the COVID-19 pandemic in some of the most populated areas of the United States. Importantly, I also depart from the previous literature using a timely data source to study suicides during the pandemic: MEOs data on suicides.

One study that looks at the relationship between suicides and COVID-19 is Faust et al. (2021). This research letter uses very preliminary data to show that death from suicide was lower than expected in 2020. Hence, their findings are similar to my findings. However, my paper differs from this study because I can observe the gender and age of the decedent. This enables me to present descriptive evidence of how suicides among school-age individuals changed after schools closed due to the pandemic. To the best of my knowledge, there is no other study that has tried to look into this. My paper also differs from Faust et al. (2021) since I can observe the county where the suicide occurred and Faust et al. (2021) data are aggregated at the national level. Therefore, I am able to account for county fixed effects in my empirical strategy.

It is a well-known fact among economists that the COVID-19 pandemic led to a meaningful increase in unemployment in the United States. Since unemployment may be linked to suicides or cause adverse effects on various aspects of health, it is worth briefly discussing some of the empirical studies that have explored unemployment and its association with various aspects of health. For example, Böckerman and Ilmakunnas (2009) use the European Community Household Panel for Finland
over the period 1996–2001 to show that the event of becoming unemployed does not matter as such for self-assessed health. However, Huikari and Korhonen (2021) use data for 21 OECD countries over the period 1960–2011 and find that a higher unemployment rate leads to an increase in suicides in almost all age groups they study. They use data on suicides and economic/financial crises to also document whether suicide mortality can be attributed to a “crisis effect” beyond that of unemployment. They find that suicides among young males (less than 45) are due to marked increases in unemployment in association with global economics crises. Also, Noh (2009) uses annual suicide rates of 24 OECD countries over the period 1980–2002 and finds evidence that the effect of unemployment on suicide rates is positive for countries with higher income. Taken together, these studies suggest it is important to study how the COVID-19 pandemic is affecting suicides since the COVID-19 pandemic led to a very meaningful increase in unemployment. Therefore, this paper attempts to provide an early empirical assessment of suicides in the United States during the COVID-19 pandemic.

Data and descriptive patterns

I use data from 19 large U.S. counties (representing 15.2 percent of the U.S. population) concerning suicides reported by MEOs from January 2017 to August 2020. All data were obtained in response to public records requests via email inquiries. I observe the age and gender of the decedent along with the date of death. Previous papers in the literature (e.g., Ruhm 2019) convert suicide counts into county suicide rates per 100,000 using county population data from the National Cancer Institute’s Surveillance Epidemiology and End Results (SEER) program. However, the 2020 SEER data are not yet available, so it is important to underline the fact that I use the total number of suicides as the outcome variable in this paper for that reason.

Table 1 lists the set of counties included in my analysis along with the dates when stay-at-home orders were effective in those counties. Except for Clark County in Nevada whose stay-at-home order was effective starting at April 1, all counties in the data had stay-at-home orders that were effective in March 2020. On March 13, President Trump declared a nationwide emergency. Nearly all U.S. public schools were closed by the end of March. Therefore, I treat March 2020 as the “event month” when performing my event study analyses below.

Figure 1 shows the evolution of the total number of suicides in each month across years in my data. The solid lines depict years 2019 and 2020 and the dashed lines depict years 2017 and 2018. Interestingly, Fig. 1 shows that the number of suicides in the data decreased from March 2020 to April 2020 but then suicides increased during the early stage of the COVID-19 pandemic from April 2020 to August 2020. Importantly, Fig. 1 also documents that the total number of suicides per month in 2020 was below previous years’ levels starting in April. Therefore, suicides were increasing during the early months of the pandemic but were below previous years’ levels.
In this section, I account for seasonal trends and county-level differences in suicides by comparing the monthly suicide counts within a given county before and after the “March event” has occurred relative to suicide counts in the county in 2017–2019. I estimate the following monthly event study model:

\[ Y_{cmy} = \sum_{\text{month}=\text{January}}^{\text{August}} \beta_{\text{month}} \cdot I(m = \text{month and } m \text{ belongs to } 2020) + \lambda_c + \mu_m + \theta_y + \epsilon_{cmy}, \]

where \( Y_{cmy} \) is the natural logarithm of the number of suicides registered by the Medical Examiner in county \( c \), month \( m \), and year \( y \). To account for seasonal trends and unobserved differences across counties, I include county fixed effects \( \lambda_c \), month fixed effects \( \mu_m \), and year fixed effects \( \theta_y \) in the regression. It is worth emphasizing that the key identification assumption of my empirical strategy is the common trends assumption in the pre-pandemic outcome over time for the treatment and control groups. The coefficients of interest are the beta coefficients \( \beta_{\text{month}} \) pertaining to the indicator functions that take a value of one if month \( m \) of observation \( Y_{cmy} \) belongs to year 2020 and month \( m \) is equal to the applicable “month” in the sum. I exclude

| County              | State  | 2019 population | Stay-at-home order date |
|---------------------|--------|-----------------|------------------------|
| Maricopa County     | Arizona| 4,485,414       | March 31, 2020         |
| Alameda County      | California| 1,671,329   | March 16, 2020         |
| Los Angeles County  | California| 10,039,107  | March 19, 2020         |
| Orange County       | California| 3,175,692    | March 19, 2020         |
| San Diego County    | California| 3,338,330    | March 19, 2020         |
| Denver County       | Colorado| 727,211        | March 24, 2020         |
| Miami-Dade County   | Florida | 2,716,940      | March 30, 2020         |
| Cook County         | Illinois| 5,150,233      | March 21, 2020         |
| Louisville County   | Kentucky| 617,638        | March 25, 2020         |
| Essex County        | Massachusetts| 789,034    | March 24, 2020         |
| Middlesex County    | Massachusetts| 1,611,699  | March 24, 2020         |
| Suffolk County      | Massachusetts| 803,907    | March 24, 2020         |
| Worcester County    | Massachusetts| 830,622     | March 24, 2020         |
| Clark County        | Nevada   | 2,266,715      | April 1, 2020          |
| Cuyahoga County     | Ohio     | 1,235,072      | March 23, 2020         |
| Dallas County       | Texas    | 2,635,516      | March 22, 2020         |
| Harris County       | Texas    | 4,713,325      | March 24, 2020         |
| Tarrant County      | Texas    | 2,102,515      | March 24, 2020         |
| Milwaukee County    | Wisconsin| 945,726        | March 25, 2020         |

Note: 2019 population estimates were obtained from the U.S. Census Bureau QuickFacts
Note: Massachusetts data was provided by Massachusetts Registry of Vital Records and Statistics. The rest of the data comes directly from Medical Examiner Offices databases

**Event study empirical strategy**

In this section, I account for seasonal trends and county-level differences in suicides by comparing the monthly suicide counts within a given county before and after the “March event” has occurred relative to suicide counts in the county in 2017–2019. I estimate the following monthly event study model:

\[ Y_{cmy} = \sum_{\text{month}=\text{January}}^{\text{August}} \beta_{\text{month}} \cdot I(m = \text{month and } m \text{ belongs to } 2020) + \lambda_c + \mu_m + \theta_y + \epsilon_{cmy}, \]

where \( Y_{cmy} \) is the natural logarithm of the number of suicides registered by the Medical Examiner in county \( c \), month \( m \), and year \( y \). To account for seasonal trends and unobserved differences across counties, I include county fixed effects \( \lambda_c \), month fixed effects \( \mu_m \), and year fixed effects \( \theta_y \) in the regression. It is worth emphasizing that the key identification assumption of my empirical strategy is the common trends assumption in the pre-pandemic outcome over time for the treatment and control groups. The coefficients of interest are the beta coefficients \( \beta_{\text{month}} \) pertaining to the indicator functions that take a value of one if month \( m \) of observation \( Y_{cmy} \) belongs to year 2020 and month \( m \) is equal to the applicable “month” in the sum. I exclude
the month of February 2020 since March 2020 is the month when President Trump declared a national emergency and when most stay-at-home policies were enacted. The excluded baseline period also includes the 2017–2019 period as a reference for 2020. Finally, the sample is restricted to months January to August in 2017–2020 when I estimate the model and I cluster standard errors at the county level.

Figure 2 presents the estimated monthly event study coefficients of interest along with bootstrapped confidence intervals. These coefficients allow me to track dynamic effects on suicides as the COVID-19 pandemic evolved. More specifically, the estimated coefficients trace out monthly changes in the number of suicides during the first eight months of 2020 relative to 2017–2019. Note that the estimated effects for January and February are equal to zero. This indicates flat pre-trends and suggests that the common trends identification assumption is plausible. The point estimate for March indicates a decrease in the total number of suicides of 8.2% relative to February, which is the reference month. The point estimates during April through August indicate decreases in the total number of suicides ranging from 11.2 to 20.5% relative to February. The decline in suicides in April and May coincides with the fact that most CARES Act stimulus checks went out during April 2020 and this may have provided some relief from the adverse economic effects of the pandemic that could be linked to suicides.

My estimation results also indicate decreases in suicides during March through August if I estimate the same model as before, but looking at the number of suicides of males and females separately. However, the estimated decrease in suicides
is larger for females. This can be seen in the third and fourth columns of Table 2, which contains the beta coefficient estimation results of all models described in the paper.

The second column in Table 2 is presented for comparison purposes between the natural logarithm and the inverse hyperbolic sine (HIS) of suicides as outcome variables. Notice estimates of the first column and the second column are very similar and hence the interpretation is similar.

Exploring the association of school closures and suicides among school-age individuals

In this section, I leverage the fact that I observe the age of decedents to explore if suicides changed after schools closed due to the pandemic. I estimate the same monthly event study regression as before, but now the dependent variable \( Y_{cmy} \) is the inverse hyperbolic sine (IHS) of the number of suicides among school-age individuals (19 years old or younger) in county \( c \), month \( m \), and year \( y \). The IHS is used to approximate percent effects by exponentiating the estimated coefficients and subtracting one, but unlike the natural logarithm, it is defined at zero. Figure 3 plots the event study regression coefficients. The point estimates during June through August indicate increases in suicides ranging from 31.3 to 43.1%. This supports the hypothesis that school closures due to the pandemic may be associated with adverse effects.

![Fig. 2 Monthly changes of ln(suicides) in 2020 relative to 2017–2019. Plots of monthly event study regression coefficients.](image-url)
Table 2  Event study models estimates.

| Dependent variable | Coefficient estimates using county month year dataset | Coefficient estimates using county month year dataset | Coefficient estimates restricting sample to the male group | Coefficient estimates restricting sample to the female group | Coefficient estimates restricting sample to school-age individuals |
|--------------------|--------------------------------------------------------|--------------------------------------------------------|----------------------------------------------------------|----------------------------------------------------------|----------------------------------------------------------|
| Beta coefficient for Jan | −0.001 (0.107) | −0.005 (0.104) | 0.066 (0.12) | −0.310 (0.217) | 0.111 (0.166) |
| Beta coefficient for Feb | 0 | 0 | 0 | 0 | 0 |
| Beta coefficient for Mar | −0.086 (0.139) | −0.085 (0.135) | −0.021 (0.134) | −0.201 (0.226) | 0.214 (0.186) |
| Beta coefficient for Apr | −0.230 ** (0.089) | −0.230 *** (0.088) | −0.189 * (0.102) | −0.354 * (0.213) | 0.077 (0.244) |
| Beta coefficient for May | −0.223 * (0.134) | −0.220 * (0.13) | −0.207 (0.151) | −0.307 (0.232) | 0.133 (0.194) |
| Beta coefficient for Jun | −0.145 (0.114) | −0.146 (0.111) | −0.148 (0.12) | −0.170 (0.188) | 0.358 * (0.186) |
| Beta coefficient for Jul | −0.125 (0.131) | −0.124 (0.128) | −0.051 (0.141) | −0.262 (0.25) | 0.272 (0.184) |
| Beta coefficient for Aug | −0.118 (0.104) | −0.119 (0.103) | −0.051 (0.121) | −0.268 (0.201) | 0.314 (0.206) |
| Feb Fixed Effect | −0.063 (0.063) | −0.065 (0.06) | −0.047 (0.063) | −0.141 * (0.081) | −0.085 (0.099) |
| Mar Fixed Effect | 0.062 (0.039) | 0.059 (0.039) | 0.046 (0.045) | 0.066 (0.096) | −0.099 (0.123) |
| Apr Fixed Effect | 0.068 (0.059) | 0.065 (0.058) | 0.063 (0.066) | 0.058 (0.075) | −0.109 (0.124) |
| May Fixed Effect | 0.154 *** (0.056) | 0.150 *** (0.055) | 0.142 ** (0.055) | 0.120 (0.086) | −0.147 (0.102) |
| Jun Fixed Effect | 0.128 ** (0.051) | 0.125 ** (0.05) | 0.125 ** (0.045) | 0.101 (0.082) | −0.326 *** (0.11) |
| Jul Fixed Effect | 0.115 ** (0.048) | 0.112 ** (0.046) | 0.124 ** (0.047) | −0.007 (0.102) | −0.182 * (0.106) |
| Aug Fixed Effect | 0.147 *** (0.043) | 0.145 *** (0.042) | 0.155 *** (0.052) | 0.079 (0.081) | −0.170 (0.145) |
| 2018 Fixed Effect | 0.045 * (0.027) | 0.045 * (0.027) | 0.043 (0.039) | 0.019 (0.063) | −0.049 (0.056) |
| 2019 Fixed Effect | −0.016 (0.033) | −0.015 (0.032) | −0.023 (0.037) | 0.009 (0.063) | −0.074 (0.065) |
| 2020 Fixed Effect | 0.021 (0.093) | 0.022 (0.091) | 0.010 (0.103) | −0.007 (0.176) | −0.293 * (0.156) |
Table 2 (continued)

| Dependent variable | Coefficient estimates using county month year dataset | Coefficient estimates using county month year dataset | Coefficient estimates restricting sample to the male group | Coefficient estimates restricting sample to the female group | Coefficient estimates restricting sample to school-age individuals |
|-------------------|-----------------------------------------------------|-----------------------------------------------------|---------------------------------------------------------|----------------------------------------------------------|---------------------------------------------------------------|
| Constant          | 2.912 *** (0.185)                                    | 3.610 *** (0.183)                                    | 3.339 *** (0.176)                                        | 2.148 *** (0.206)                                        | 1.103 *** (0.146)                                             |
| Mean of dep. variable | 2.97                                               | 3.66                                               | 3.40                                                   | 2.13                                                   | 0.91                                                          |
| N                 | 608                                                 | 608                                                 | 608                                                    | 608                                                    | 608                                                           |

Notes: Estimation uses data on suicides from Medical Examiner Offices pertaining the months January – August in 2017–2020 period
IHS(suicides) refers to the inverse hyperbolic sine of the number of suicides for each county, month and year
ln(suicides) refers to the natural logarithm of the number of suicides for each county, month and year
February is the omitted month since March is the "event" month. Hence, the beta coefficient for February is zero
All models include county fixed effects and standard errors are clustered at the county level

*p<0.05, **p<0.01, ***p<0.001
on school-age individuals. The point estimates during March through May indicate an increase in suicides ranging from 8 to 23.9% but, they are smaller in magnitude than the summer months’ estimates.

The evidence presented in this section is descriptive, but there might be several factors associated with the documented increase in suicides of school-age individuals during the early stage of the pandemic. For example, school closures may have created barriers to access counselors and mental health wellness checks that are usually provided at schools. Also, extended family networks provided by the school community that help support school-age individuals mental health might have been severely affected by social distancing policies and school closures. Hence, more research and better data are needed to determine if the documented increase in suicides among school-age individuals was caused by school closures. School closure policies were an endogenous policy response to the arrival of COVID-19 and estimating a causal effect is beyond the scope of this paper, but this paper presents some preliminary descriptive evidence regarding this topic.

Conclusion and discussion

This paper uses MEOs suicide data from 19 largely populated counties in the United States and finds no evidence that the total number of suicides increased during the pandemic relative to previous years’ levels. Using a monthly event study design to account for seasonal trends and county-level differences in suicides, I find that
during April through August 2020, monthly suicides were between 11.2 and 20.5% lower than previous years. Finally, when I explore whether school closures during the start of the pandemic might be associated with suicides among school-age individuals, I find that monthly suicides increased relative to previous years for this age group.

In terms of policy implications, this latter result seems to suggest it is very important to keep monitoring school-age individuals in urban US counties during the rest of the COVID-19 pandemic. Nationally, the suicide rate among persons aged 10–24 was statistically stable from 2000 to 2007 and then increased 57.4% from 2007 to 2018 (Curtin 2020). This means that even before the COVID-19 pandemic, suicides among school-age individuals were already an important public health concern. Moreover, my estimation results show suicides among school-age individuals increased in 2020 relative to previous years due to the pandemic. Therefore, it is not unreasonable to conclude that school-age individuals can be a vulnerable group for the rest of the pandemic and that public health officials should keep monitoring suicides among them closely.

It is worth emphasizing some limitations of this paper. First, there are some disadvantages of using MEO data. As mentioned before in the introduction, economists typically study suicides in the U.S. using CNHS’s Multiple Causes of Death individual-level data. These data are more reliable than MEO data since they are nationally representative, and before releasing the data, the CDC verifies the causes of death for all death certificates associated with the deaths included in the dataset. The CDC also makes available a richer set of demographic variables than the ones contained in the MEO data, which enables economists to perform more detailed analysis of suicides across demographics like county of residence, age, race, gender, education, year, and weekday of death [see, for example, Ruhm (2019)]. MEO data can also have slight delays in records being completed due to procedures, investigations, and backlog. However, given the importance of studying whether suicides were increasing or not during the COVID-19 pandemic, I opted use MEO data for this study by filing multiple public records requests with each county’s Medical Examiner included in this paper. Also, as mentioned before, the 2020 national suicide individual-level data from the CDC are not available yet. Therefore, I decided to contact the MEOs of many urban U.S. counties to provide an early empirical assessment of suicides in the U.S. during the pandemic. Second, the descriptive evidence presented in this paper does not imply mental health was not severely affected by the pandemic or that other deaths of despair did not increase. One of the limitations of this paper is that it only studies suicides, but further research is needed in studying other relevant outcomes that might have been impacted by the pandemic, such as mental health ER visits. Third, my empirical strategy does not estimate the causal effect of the COVID-19 pandemic on suicides. I limit myself to provide event study estimates that allow me to remain agnostic about the exact point when the COVID-19 pandemic started to affect suicides. The main goal of this paper is to describe how suicides are evolving during the pandemic using data from large counties, but further research is needed once the restricted 2020 CNHS’s Multiple Causes of Death data are available or comprehensive administrative data can be accessed by researchers. Finally, the collected data are not representative of the entire United States since it
only focuses on heavily populated areas. This means that my descriptive results do not speak to what rural areas in the United States might be experiencing during the pandemic and that I cannot draw any policy implications of my results for those rural areas.

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**Declarations**

**Conflict of interest**  On behalf of all author(s), the corresponding author states that there is no conflict of interest.

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